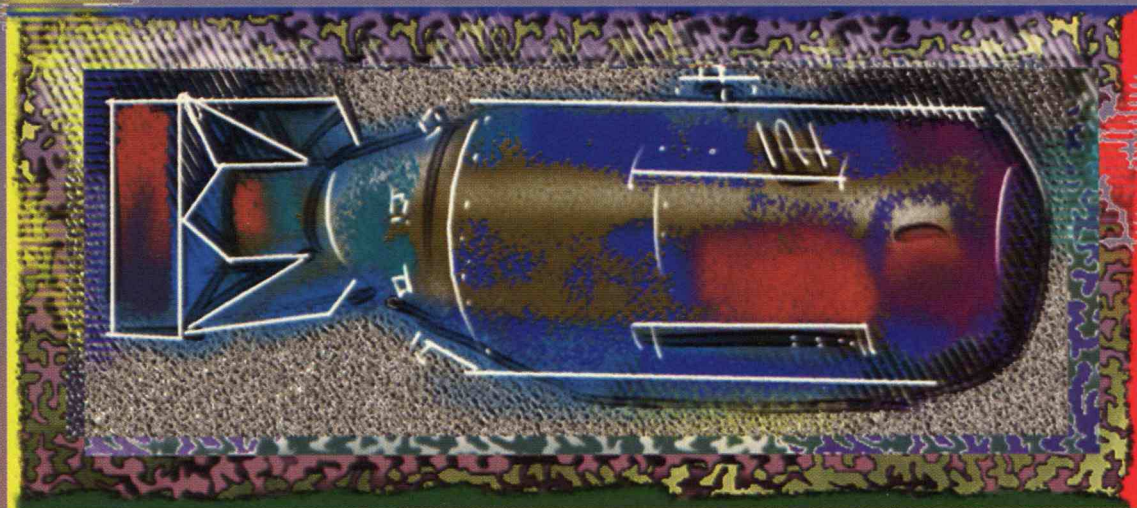


Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

AUGUST/SEPTEMBER 1995

\$3.75/CANADA \$4.95



Little Boy

THE Atomic Age ^{AT} 50

TWENTY-ONE EXPERTS REFLECT ON
HIROSHIMA AND NAGASAKI, THEIR AFTERMATH,
AND THE FUTURE

- ♦ Did We Need to Drop the Bomb? ♦
- ♦ Why Can't We Talk About It? ♦
- ♦ What Was the Price of the Cold War? ♦
- ♦ Can We Rid the World of Nuclear Weapons? ♦
- And Should We?



SPECIAL ISSUE

technology review

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
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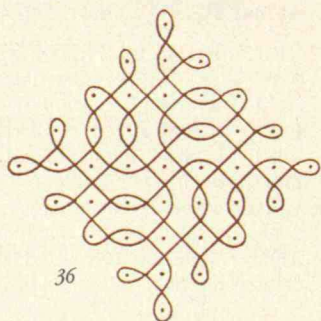


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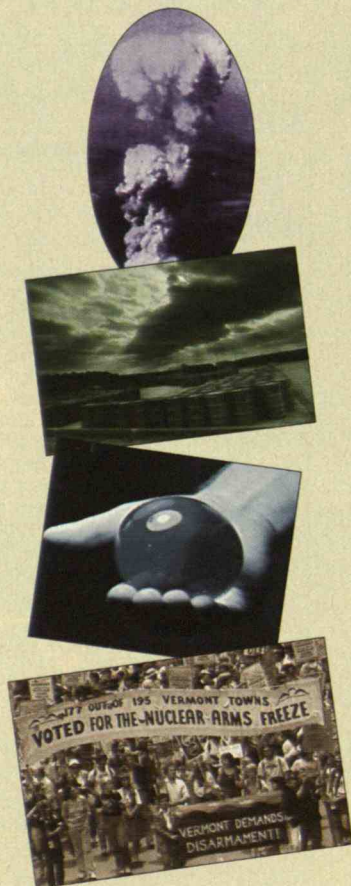
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Technology Review (ISSN 0040-1692), Reg. U.S. Patent Office, is published eight times each year (January, February/March, April, May/June, July, August/September, October, and November/December) by the Association of Alumni and Alumnae of the Massachusetts Institute of Technology. Entire contents ©1995. The editors seek diverse views, and authors' opinions do not represent the official policies of their institutions or those of MIT. We welcome letters to the editor. Please address them to Letters Editor, c/o address below or by e-mail to: <technology-review-letters@mit.edu>.

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Subscriptions: \$30 per year. Canada add \$6, other foreign countries add \$12. Contact *Technology Review*, P.O. Box 489, Mount Morris, IL 61054, (800) 877-5230 or (815) 734-1116; FAX (815) 734-1127, or e-mail to <trsubscriptions@mit.edu>.

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First Line

The Atomic Age at 50

DURING the 1980s I could panic at the sound of a siren and often woke during the night with a pounding heart. Although I was a veteran of the “duck-and-cover” days, when schoolchildren had to practice crawling under desks at the wail of an air-raid siren designed to warn of impending nuclear attack, the spectre of atomic war had seemed remote. But President Reagan’s inflammatory rhetoric and the massive U.S. arms buildup had apparently convinced me that someone might actually push the button.

Fortunately, the constant fear of nuclear armageddon now no longer haunts us. But the first half-century of the nuclear age, marked this August by the fiftieth anniversary of the bombing of Hiroshima and Nagasaki, saw a relentless quest by two powerful nations to acquire ever-more-sophisticated nuclear weapons. That arms race and those weapons—the ultimate embodiments of the human capacity for both technological genius and self-destruction—leave a legacy that will endure for generations. *Technology Review* has devoted much of this issue to examining that legacy.

Covering the dilemmas of the arms race is not new to the magazine. During past decades numerous *TR* authors have analyzed the effects of innovations such as “multiple independently targetable reentry vehicles” (better known as MIRVs) and stealth on the strategic balance, proposed alternatives for reversing the arms race and preventing proliferation, and debated the feasibility of attempts to create a foolproof missile defense.

Writing in this issue of the decision to use atomic weapons on Japan, historian I.B. Holley, Jr., decries “Monday-morning quarterbacking of scholars long after the event.” An Air Force officer during World War II, he notes that whether the decision seems wise or unwise depends on your perspective. The real question, he says, is: Did the bomb save lives? The answer of journalists Norman Polmar

and Thomas B. Allen is a resounding yes; they recount the horrifying loss of life on both sides during the Pacific campaign and assert that the bomb averted what promised to be “the bloodiest invasion in history.”

Yet events as momentous as the use against civilians of the most powerful weapon ever devised inevitably entail moral complexity. In our collection’s lead essay historian John W. Dower not only recounts the many motivations that might have propelled this awesome

A Special Issue on a special anniversary

move but bemoans the nation’s recent loss of opportunity to reflect on it—the Smithsonian Institution’s decision to drastically scale back a planned exhibit on Hiroshima and Nagasaki and their aftermath. U.S. Rep. Peter Blute (R-Mass.) counters that the reason for killing the proposed exhibit was simple: it was fatally flawed.

Public debate of the events spawning the atomic age would have been particularly important, psychiatrist Robert Jay Lifton and journalist Greg Mitchell maintain, because the “cumulative influence of Hiroshima is much greater than most Americans suspect.” In U.S. censorship of on-site footage from Hiroshima and Nagasaki and official reference to agonizing radiation deaths as “hoaxes and propaganda,” these authors see the start of “patterns of...concealment that have contaminated American life ever since.” Yet if secrecy and fear have often prevented a closer examination of this excruciating time, communications professor Brian C. Taylor shows how novels and films about irradiated monsters and post-nuclear landscapes have provided alternative vehicles for expressing the “shock, fantasy, regret, denial, and resolve of society as it has struggled with the possibility of nuclear destruction.”

Ironically, even as we indirectly dealt with this grim reality, historian Alex

Roland maintains that by convincing the superpowers to avoid all-out confrontation, the bomb actually reversed the accelerating growth in war-related deaths set off by the Industrial Revolution, thus saving hundreds of millions of lives. Yet deterrence posed its own contradictions: political scientists Richard Ned Lebow and Janice Gross Stein show that it fueled the arguments of advocates for unlimited atomic arsenals and encouraged brinkmanship that made nuclear launch imminent on more than one occasion.

Dealing with those massive arsenals and vast quantities of associated detritus poses an unprecedented challenge. *TR* authors make it clear that meeting that challenge will require all the technological, political, and social resources the global community can muster. Defense analysts Jonathan Dean and Randall Forsberg, for example, present a comprehensive three-stage plan to wean nuclear and would-be-nuclear nations alike from equating the bomb with ultimate security. To help ensure against future efforts to build atomic weapons, several authors propose putting fissile material under the watch of international monitors. Pointing out that the world’s “inventory of plutonium produced in nuclear [power] reactors now totals about 1 million kilograms, nearly five times the amount produced for the world’s nuclear weapons,” former weapon designer Theodore B. Taylor would phase out the entire nuclear enterprise.

Although these authors’ ultimate goal of a nuclear-free world may seem beyond humanity’s grasp given endemic levels of global violence, physicist Joseph Rotblat maintains that failure to take action will result in a much more dangerous world in which many nations feel “entitled to [their] own nuclear deterrent.” Citing the millions of people worldwide who actively urged disarmament during the height of the nuclear standoff, physician and Nobel Peace Prize winner Bernard Lown sees citizen diplomacy as equally essential in convincing leaders to embrace a more hopeful future. ■

—SANDRA HACKMAN

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Letters

NASA THINKS SMALL

As Bruce Berkowitz notes in "More Moon Probe for Your Money" (*TR* April 1995), Administrator Daniel Goldin and other senior agency officials of the National Aeronautics and Space Administration are leading major efforts to incorporate the relevant parts of the *Clementine* mission, including shorter development schedules and streamlined budgets and staff, into the way NASA conducts business. But Berkowitz is far too quick to dismiss these efforts as "only a small portion of NASA's activities."

As chief of the Small Missions Development Branch in NASA's Solar Systems Exploration Division, I am responsible for the *Discovery* series of scientific probes mentioned in the article and the Mars program. The current *Discovery* flight projects, Mars Pathfinder and Near Earth Asteroid Rendezvous (NEAR), are being developed for less than \$150 million (1992 dollars), excluding launch services. Earlier this year, NASA selected Lunar Prospector as a new *Discovery* project. With its goal to fill in missing links in our knowledge about the moon, Lunar Prospector is slated for completion by 1997 and will cost \$59 million, including launch expenses.

The Mars Surveyor '98 missions involve the construction of an orbiter and lander at the cost of \$92.2 million. The current Mars Global Surveyor (MGS) is on a development schedule of 28 months at a cost of \$154 million, excluding launch expenses. The MGS will fly five of the seven instruments from the prior Mars Observer program.

All the missions I have mentioned have project management structures that are at least half the size of the one for Mars Observer. While the total value of these missions may not constitute a huge percentage of NASA's budget, they are nonetheless very high priorities for the agency.

WILLIAM L. SMITH
National Aeronautics
and Space Administration
Washington, D.C.

Bruce Berkowitz skims over the central reason why space missions incur high costs: the need for ultra-reliability. Spacecraft must function for extended periods of time without any opportunity for repair. Without its ancillary agenda to investigate the moon, *Clementine* might have been labeled a failure since it was unable to perform the Ballistic Missile Defense Organization's original mission of testing defenses in space against actual missiles. Very few programs have the luxury of being hailed a success for performing a secondary mission instead of its primary one.

THOMAS W. JOHNSON
Albuquerque, N. Mex.

Although Bruce Berkowitz captured the implications of *Clementine* for future space activities, I was disappointed by his omission of the project role played by Lawrence Livermore National Laboratory. At least an equal partner with the Naval Research Laboratory, we built all seven cameras for *Clementine*, produced much of the mission software, and made all the data easily accessible by putting it on the Internet.

C. BRUCE TARTER
Director
Lawrence Livermore National Laboratory
Livermore, Calif.

THOUGHT FOR FOOD

The life-cycle analyses of convenience foods that Lester Lave, Tse-Sung Wu, Chris Hendrickson, and Francis McMichael advocate in "My Shopping Trip with André" (*TR* February/March 1995) inappropriately seek to combine



market prices with unknown and in many cases incalculable environmental costs. Consumers don't—and probably can't—conduct such computations because they're virtually impossible to do. Life-cycle analyses require the identification of both the obvious and not-so-obvious environmental damage caused by a

product or a process. While the release of toxic chemicals from a manufacturing facility is easily identifiable, the environmental harm caused by the burning of fuels—say, to produce the energy to make one component of a product—is not.

As technologies change, so will the risk levels associated with certain products and processes. Could any organized body, including the government, be expected to keep track of all such developments? And even if it could, the “right” life-cycle analysis would still be unavailable to consumers because so many of these effects are unquantifiable.

An alternative approach to life-cycle analyses attacks the environmental harms or inappropriate resource uses where they occur instead of trying to calculate the damage at the end of the cycle. The advantage of such an approach is that it focuses directly on the environmental problem rather than trying to trace back through the complex interconnections of the economy.

RICHARD D. MORGENSTERN
Visiting Scholar
Resources for the Future
Washington, D.C.

DISINTERESTED EQUATIONS

In “Sheriffs of Scientific Correctness” (*TR February/March 1995*), Langdon Winner revealed a shocking gap in my physics education. He says that “a growing number of writers observe that even the knowledge claims of physics and biology are shot through with subjective judgments about the abilities of males and females as well as different ethnic groups.” Had I somehow missed this important point in spite of outstanding tutelage by the MIT physics faculty?

I reviewed the equations of mechanics and electromagnetism in both their classical and quantum mechanical forms. I even studied the equations using a mirror to obtain left-right inversion. I concluded that the equations of physics are supremely indifferent to the points raised by Winner. The equations also appear to have little to say about matters of diversity, multiculturalism, or the bounties of the rainforest.

GREGORY R. JOHNSON
St. Louis, Mo.



BLENDING FACT WITH VALUE

In “Suffer the Little Children” (*TR April 1995*), Stephen Solomon examines the ethical dilemmas health care professionals face in providing advanced medical treatment. However, in his reference to the Oregon health prioritization project, Solomon incorrectly concludes that its primary goal was saving money.

The Oregon legislature developed the prioritization project in an effort to provide health care to a greater number of state residents, even at the cost of increasing expenditures. Through consultation with health care experts and surveys intended to determine the community’s health care priorities, the Health Services Commission spent four years weighing the ethical questions posed by certain kinds of treatment and it derived what it considered to be an effective and efficient package that blended fact with value.

But the federal government interpreted biases against certain segments of the population, criticizing the prioritization project for discriminating against the disabled under the Americans with Disability Act. The federal government thus weakened the commission’s project; in particular, it had the commission drop its recommendation that only comfort care be provided to babies whose gestational age was under 23 weeks and whose birth weight was less than 500 grams. Although the commission had based the recommendation solely on the inevitability of death, the federal government was concerned that it violated the Child Abuse Amendment by singling out children with underdeveloped body systems.

Until ethics and technology are in agreement, the public will continue to

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LETTERS

pay a great emotional price and the health care system will continue to undergo financial drain at the expense of preventive services.

PAIGE R. SIPES-METZLER
Executive Director
Oregon Health Services Commission
Portland, Ore.

ENERGY EFFICIENCY

Since I share Flavin and Lenssen's concerns about environmental quality, I hope their forecasts in "The Electricity Industry Sees the Light" (*TR May/June 1995*) for an electricity industry that depends more on decentralized power generation and renewable energy sources are correct. But, as the debates continue and the industry structure develops, we should remember that the goal for the future electric industry is not only environmental quality but also economic efficiency.

Curiously, Flavin and Lenssen provide little information about efforts by utilities to help customers become more energy efficient. The discussion of smart utilities providing real-time pricing does not consider that this method will encourage consumers to demand more electricity off-peak when prices are low. Real-time pricing will have a major effect on when electricity is used but not on how much electricity is consumed.

The authors also envision an industry in which wholesale competition is widespread but retail competition is limited. Their model includes a retail monopoly franchise for local utilities, which can then plan on behalf of all customers in their service area. However, some groups strongly favor "retail wheeling," which enables customers to choose their energy supplier.

ERIC HIRST
Corporate Fellow
Oak Ridge National Laboratory
Oak Ridge, Tenn.

Readers of Flavin and Lenssen's excellent review of the electric industry may wonder how their vision relates to proposed retail wheeling—letting retail customers buy power from any supplier at market prices. This development has been widely but falsely reported as imminent nationwide.

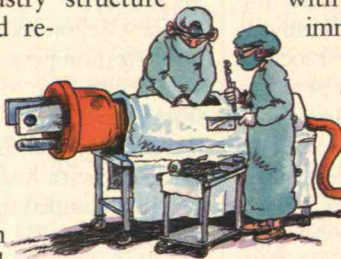
No state has authorized retail wheeling and none seems likely to. The president of the five-member California Public Utilities Commission unexpectedly proposed retail wheeling in 1994, but it got only one vote in May 1995. Nevada offered it to woo operators of a steel rolling mill into the state in 1994, but the plant has still not materialized. Michigan authorized a small experiment with retail wheeling in 1994, but immediately landed in court.

Wrapped in the superficially attractive rhetoric of choice and competition, retail wheeling has a venal motive: industries using 4 percent of the nation's electricity want to grab the cheapest power and bur-

den ordinary consumers with costlier plants, which are primarily nuclear. The Federal Energy Regulatory Commission said in March 1995 it will not allow such unfairness.

Talk of retail wheeling nonetheless caused panic among utility managers. Expecting that rewards for selling more power would resume and that only low rates would matter, they have slashed highly cost-effective programs aimed at encouraging customers to cut bills by using electricity more efficiently. The immense benefits of saving electricity (ultimately worth perhaps more than \$100 billion per year nationwide) rather than generating more of it are thus being sacrificed for the much smaller benefit of buying bulk power competitively. Yet that benefit will be captured by wholesale competition already required by federal law. Combined with proper state regulation that rewards utilities for cutting customers' bills, wholesale competition will yield both benefits.

Especially if everyone buys bulk power



at competitively equalized prices, utilities will need strong customer-efficiency programs to distinguish their service from that of other providers. When competition was introduced into the natural gas, airlines, and telecommunications industries, the winners were not the lowest-priced commodity sellers but the best providers of retail service. It is only the highly productive use of electrons that can yield far better service at far lower cost.

AMORY B. LOVINS
Director of Research
Rocky Mountain Institute
Snowmass, Colo.

Though I found Flavin and Lenssen's article an accurate exposé of the new electric power industry, their discussion of decentralized power generation did not seriously consider energy storage issues.

Storage of centralized power has been limited to large, site-specific systems. Compressed-air and pumped hydro energy storage provide five to seven hours of backup power, while superconducting magnetic energy storage meets quick-response needs like second-to-second variations in transmission lines. The advent of decentralized power generation necessitated the development of battery energy storage systems, which provide relatively near-term, cost-effective, and clean technology. The batteries are charged from a grid or a local source during off-peak times to store power for one-half to two hours. In the near future, the size of these systems are expected to shrink to that of a commercial power transformer and offer efficient storage for up to four hours.

ALBERT A. KOENIG
Manager
Advanced Battery Systems
Silent Power, Inc.
Valley Forge, Pa.

The trend toward small, competitive, decentralized suppliers of electric power described by Flavin and Lenssen could be just what the United States needs to shift to a long-term, sustainable, environmentally sound energy future.

Although large centralized facilities will remain important energy sources for quite some time, they could be gradually augmented or supplanted by independent power producers—both corporations and individuals—producing power at the community level. With the federal government's Energy Policy Act of 1992 encouraging this shift, increased competition among both large and small suppliers of electricity should bring power costs down and reduce our addiction to fossil fuels and nuclear energy.

CRAIG W. ZINDLER
Shippensburg, Pa.

A POWERFUL REPORT

In "The Legacies of World War II: A Roundtable Discussion" (*TR May/June 1995*), I noted with interest that the editor, David Brittan, writes, "Vannevar

Bush presented [the report entitled *Science—The Endless Frontier*] to President Franklin D. Roosevelt in July 1945." This is quite remarkable since Roosevelt died in April 1945. Besides being "insightful, influential, but overcited," the report also represents irrefutable evidence of communication with those who have passed on to the other side.

JEFFREY I. STEINFELD
Professor of Chemistry
MIT
Cambridge, Mass.

Editor's Note:

It was of course President Harry Truman who received *Science—The Endless Frontier* in July 1945. We regret the error; no political or spiritualist implications intended.

Continued on page 87

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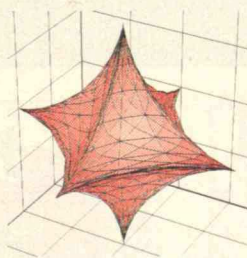
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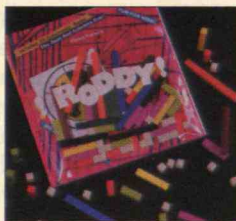
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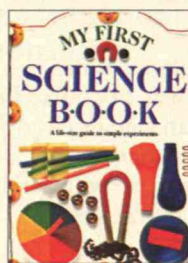
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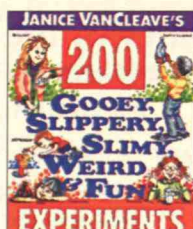


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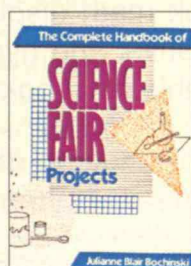


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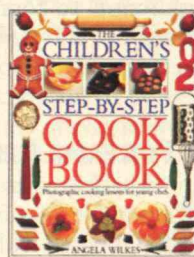


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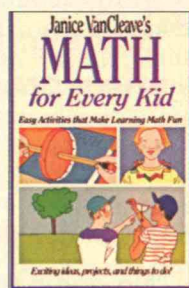


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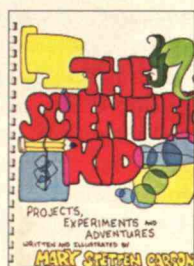


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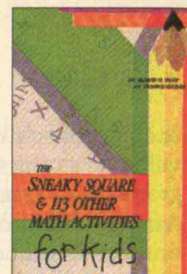
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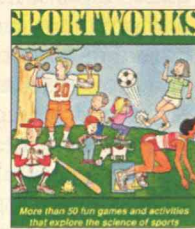
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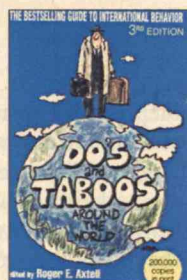


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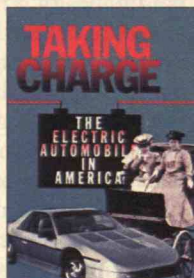


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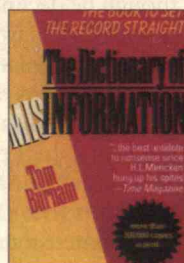


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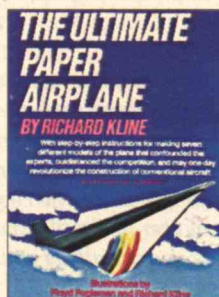


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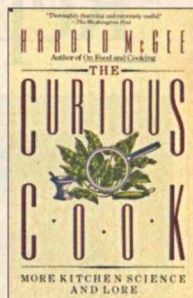


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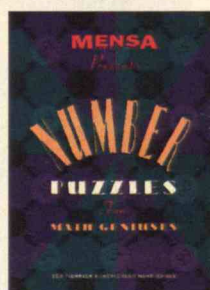
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MIT Reporter

A PROGRAM THAT PUTS A SMILE ON YOUR FACE

 The photographic image that the computer-attached camera took of Tomaso Poggio showed him staring straight ahead, not smiling an iota. But then, on the monitor, the image changed to show him grinning, then turning sideways, then looking up, and down.

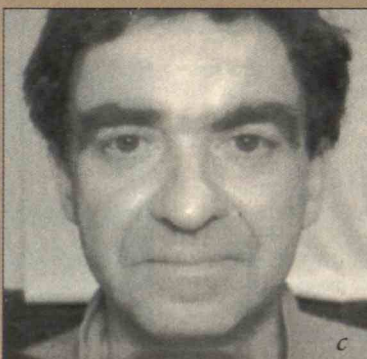
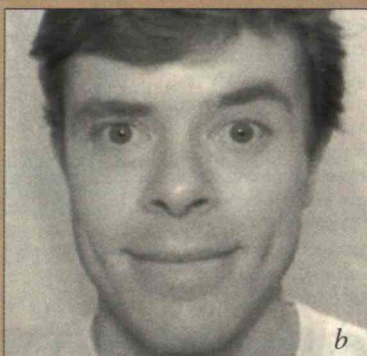
Poggio, a professor in the Department of Brain and Cognitive Sciences and codirector of the Center for Biological and Computational Learning at MIT,



was putting his team's technology through some of its paces. Over the past five years a group headed by Poggio, who is also a member of MIT's Artificial Intelligence Laboratory, has been developing a variety of programs that combine computer-graphics techniques with artificial intelligence to create new images based on one or more pairs of images. For instance, after analyzing four pictures—one in which a person is smiling, another in which the individual is stone-faced, and others in which the person is looking ahead and then facing sideways—the programs can interpolate among the pictures to draw an image of the person with a variety of intermediate expressions.

The newest program, created by Poggio and graduate student David Beymer, can also analyze photographic images of one person and a single image of a second person to devise pictures combining different aspects of all the images. The image of a smiling Poggio, for instance, was possible because the system had previously analyzed several scanned-in photos of another person—in this case, Beymer—showing a variety of facial gestures and poses.

Similarly, an earlier program can mix its "learned knowledge" of line-drawn images, such as illustrations of Garfield the cat, with new information, such as simple childlike drawings depicting various eye positions, to create pictures of Garfield rolling his eyes, say, or blinking. People not schooled in drawing could use the system to turn rough sketches into pictures that look professional, says



Stephen E. Librande, a former graduate student who created that software with Poggio. Librande has gone on with Poggio to help found nFX, a Santa Clara, Calif., company that is licensing some of the technology to video-game manufacturers and desktop publishers.

The more images the system analyzes initially, the more variables it can handle during the creation of each new picture. A cartoon video shows how the Poggio team's software can make numerous changes per video frame given 8 original images of a mouth and 32 of a set of eyes to devise thousands or more new images. Thus cartoon artists could draw a relatively small number of images of, say, a karate fighter, then direct the trained system to create many intermediate pictures showing a combination of kicking, blocking, and other basic moves. "If you can use a computer to do complex operations for cartooning, then you're going to save time," says Clark Dodsworth, a computer-graphics consultant in San Francisco. Librande says three companies that want more bang for the buck from cartoonists have recently licensed the technology, although he declines to name the firms for proprietary reasons.

The interpolation method the Poggio-team programs rely on to create imagery confers one disadvantage. Unlike computer-graphics programs that generate two-dimensional images after a computer has first represented an object in three dimensions, with x, y, and z coordinates for each pixel (point on a computer screen), the MIT method currently deals with only 2D images. The resulting images therefore cannot be shaded or lit as accurately and simply as those made by the other techniques, Poggio says.



After analyzing scanned-in photographs of a person (here, graduate student David Beymer, a and b), a computer program can manipulate an image of a second person (professor Tomaso Poggio, c) to create another image (d). The program is set up to work only with the central portion of the face.



The technique required relatively little information to produce this cartoon from previously drawn images (opposite page). Intrigued with such economy, Poggio's team is developing a videoconferencing program that will transmit fewer data between sending and receiving computers than needed today.

At the same time that his group endeavors to extend its technology so it can also work with 3D models, the team is examining whether it can further develop the system for use in videoconferencing. Unlike most of today's videoconferencing methods, not much information would have to travel between sending and receiving computers using the Poggio group technique. After the computers had trained on the basic images, the only data transmitted would be simple instructions for building interpolated gestures and poses—a few bytes per video frame compared with the thousands or more sent today, according to Poggio.—LAURA VAN DAM

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DEFENDING AN ENDANGERED ACT

When Stephen Meyer gets ticked off, he tends to speak in italics. He has been speaking in italics a lot lately, ever since the Endangered Species Act, which he supports, came under heavy fire in both the House and the Senate this past spring.

It was bad enough when he assumed that the act's reputation for damping economic growth had some basis in fact. In those days, Meyer, a professor of political science and the director of MIT's Project on Environmental Politics and Policy, would simply retort that wildlife protection was "for the good of the country, and just as we don't allow prostitution or drug sales or slavery or child labor, we also don't allow you to wipe out every species around just to

make money." But now that he has completed a study designed to measure the economic impact of the Endangered Species Act at the state level—to affix some hard numbers to a problem that critics vaguely describe as "large" or "devastating"—he cannot emphasize enough his dismay over the movement to weaken the act. That movement, according to his findings, is based on a false supposition. Worse yet, he says emphatically, "I think it's unstoppable."

On the face of it, Meyer's study appears capable of at least giving the critics pause. The study looked at economic growth trends in all 50 states between 1975 (two years after the Endangered Species Act became law) and 1990. Its premise was that if the act hampers growth, then the economies of states with the largest share of the country's 955 species listed as endangered or threatened should have fared the worst. Contrary to all expectations, including Meyer's own, neither construction employment nor gross state product—the two measures he used—showed any sign of languishing as a result of the act. For example, Alabama, home to 70 listed species, boomed; Louisiana, with only 21 listings, did poorly. In fact, if there was a trend among states with many listed species, it was toward faster growth, not slower. This was true even when Meyer took into account such variables as relative land areas, dependence on natural resource industries (which are prone to slumps), size of the economy, and changes in the number of listings over time.

No, wildlife protection isn't a remedy for sagging economies, says Meyer—for it is strong growth that produces endangered species, and not vice versa. And no, the study isn't conclusive. Meyer admits things get a little murky when you compare species that have unequal or overlapping habitats, and he is up front about the possibility that some economic harm could be occurring at the local level. Still, he writes in "Endangered Species Listings and State Economic Performance"—a working paper he released in March—the data he examined "strongly contradict the assertion

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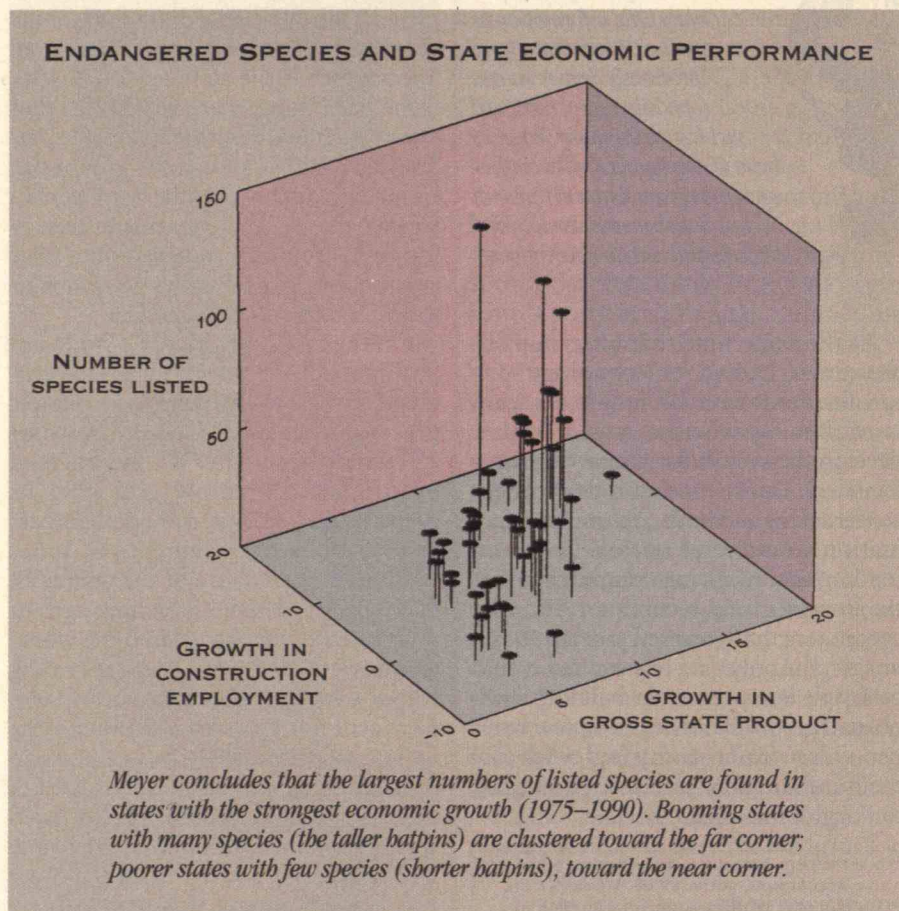
that the Endangered Species Act has had harmful effects on state economies." Even at the county level, where Meyer has since begun hunting for mischief that might not have shown up at the state level, "the evidence is just not there."

So why is Meyer not satisfied that he has struck a crucial blow for wildlife preservation? Why is he not confident that environmental groups, business interests, and politicians will now move on to something more productive than fighting over owls? Why, in short, is he ticked off?

Because science is no match for politics, he says. Meyer got a taste of this in May, when he and E.O. Wilson, the Harvard biologist, were invited to testify at House hearings on the Endangered Species Act and then uninvited at the last minute by majority staffers who, he says, wanted to bar testimony for which they could find no rebuttal. "Academics always think they're going to show policy-makers what's what," he says with a laugh. But it had been apparent to him for some time that endangered species laws are an easy target, no matter how strong the scientific evidence in their favor.

For one thing, wildlife protection has a weak constituency, even compared with other environmental issues. "It's hard to be against clean air and clean water," says Meyer, "because people are sensitized to questions of cancer and toxic fumes, and everyone wants to turn on the tap and get clean water." But the Endangered Species Act, even though it has essentially raised the bald eagle and many other species from the dead, "is an orphan environmental program: the average person doesn't think, 'If this species disappears, my life will change.'"

At the same time, the act has powerful opponents. Development and real estate groups, convinced that species protection drives land values down and discourages building, have lobbied hard to amend the legislation. So have timber, mining, ranching, and utility interests—even to the point of being "heavily involved" in drafting a reform bill introduced in May by Sen. Slade Gor-



ton (R-Wash.), according to the *New York Times*. The purpose of the Gorton bill was to remove most of the act's teeth. It proposed to do away with penalties for destroying endangered species habitat on private land, for example, and to let the secretary of the interior decide whether the habitat of newly listed species should be preserved.

If the act is wide open to such attacks, environmentalists are not blameless. "They should never have called it the Endangered Species Act," Meyer complains, "because that allows a congressman to say, 'How can saving any one species be worth the trouble?'" Likewise, all the fuss over saving the spotted owl in the Pacific Northwest may have backfired, giving the impression that it was owls versus people. The Endangered Species Act is really about ecosystems, not species, says Meyer. "When

you protect the spotted owl, you protect the old-growth forest, and when you protect the old-growth forest, you protect the 100 other species in there that you may or may not know about."

But the main reason Meyer feels less than triumphant about his scientific study is that scientific studies are not the currency of democratic government. "Public policymaking is ruled by anecdotes," he says. "You'll hear somebody testify in Congress, 'Well, in my home state of Kentucky there was an old woman who wanted to cut down her hedges to clear a view, and the Fish and Wildlife Service wouldn't let her.' Or a congressman stands up and says that finding the red-cockaded woodpecker at Fort Bragg has effectively prevented the Army from doing exercises and weakened our military capability." Indeed, one of the tactics employed by Rep.

GET YOUR GAME DOWN TO A SCIENCE

Richard Pombo (R-Calif.), a key opponent of the Endangered Species Act, has been to scour the South and West of the country looking for citizens who say that fish, turtles, or owls have ruined their lives.

Stretching the Truth

The trouble is, says Meyer, "science almost always looks weak in public policy compared with anecdotes. When I tell you an anecdote, I omit anything that might cloud the picture. But as a scientist, I point out uncertainties in the data, I point out missing information, I point out alternative explanations for why those outcomes came about."

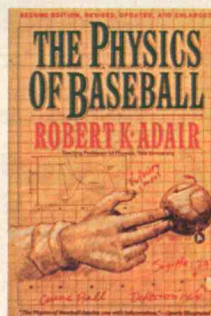
Often, Meyer complains, the anecdotes that influence policy—like anecdotes generally—fall apart under scrutiny. "You call the woman in Kentucky about her hedges, and she says, 'That's not what happened at all. I wanted to cut down the hedges, and they told me this might be endangered species habitat, so I got a special permit and I cut 'em down.'" Meyer says he phoned the Fort Bragg press office to check out the congressman's account of the red-cockaded woodpecker and was told that the bird's presence had not disrupted training in the least; someone had simply painted all the trees where woodpeckers lived to avoid knocking them over. And yet such stories have the power to "cause a stampede among congressmen who otherwise could care less about the issue," he observes hotly.

What really ticks Meyer off, though, is the thought of what might happen if his findings remain excluded from the political debate over the Endangered Species Act. "Five years from now, when they're called to task for gutting the act, the politicians will say, 'Well, *we* didn't know. *Nobody* knew back then. If we had *known* that endangered species protection doesn't cost anything at all, we would have been in *favor* of it.'" He is speaking in italics again, punching out the words as if determined to make his voice carry beyond the four walls of his office.—DAVID BRITTAN

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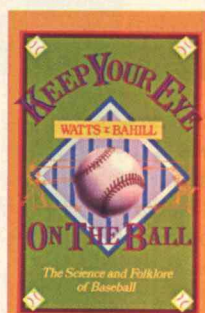
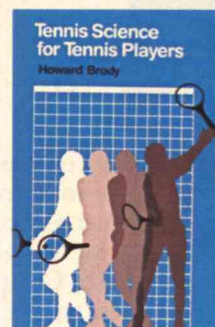
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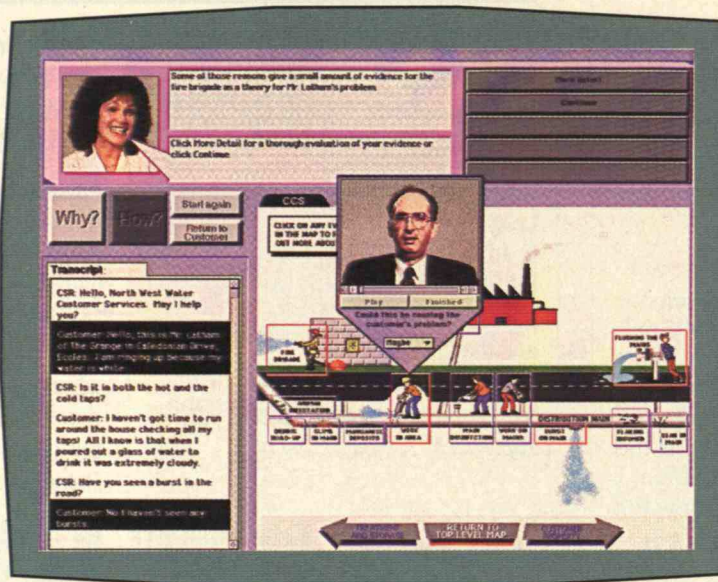
Trends

AI as Training Tool

You are on your first day of your new job as a customer service representative for North West Water, one of Great Britain's largest private utilities, when a worried customer calls. There are little "bits in the water," she says. So you ask what you think is a logical question: "Are they swimming?" The caller excitedly answers, "Yes, they're swimming all around." You know that little swimming things might be microorganisms, so you tell the customer the water is contaminated, warning, "Whatever you do, don't drink it!"

The customer hangs up and calls the health department to complain and possibly blemish the company's record. Unfortunately, if you had just asked a few more questions of a few more people, you would have learned that a water crew had been working in the neighborhood and that the things "swimming" in the water weren't contamination at all, but rust and dirt particles kicked up in the pipes when the crew flushed a nearby line. You would also have known to advise the caller that they would disappear if she would simply run the water for a minute or two.

Luckily for you, this phone call is only a simulation. Everything from the ring of the phone to the spoken voice of the caller takes place on your Macintosh computer. Instead of speaking to the computer, you use the mouse to select the questions you want to ask. The computer responds by selecting and playing an appropriate response from a library of video clips from the customer or other sources, mainly former North West Water service representatives, each with a story designed to help you learn your way around your new position. When you do your job correctly, on-screen



An AI-based simulation created to train service representatives at a water utility engages users in realistic dialogues with virtual customers. A mentor (top left) helps trainees query customers, experts, maps, or other documentation to solve problems.

mentors encourage you; when you make a mistake, they explain what you did wrong by telling you about a time when they did exactly the same thing.

Welcome to the future of corporate training, as envisioned by the Institute for the Learning Sciences (ILS) at Northwestern University. Software designers at the institute have been developing simulations that merge the fields of artificial intelligence (AI) and multimedia technology to create learning environments to help companies save costs while improving the quality of their employee training.

Because people learn better from making mistakes than from being told the right things to do, says Roger Schank, long-time AI researcher and founder of ILS, his software immerses the users in a believable simulation, allows them to make mistakes, and uses AI to respond accordingly. All of the simulated characters have a wealth of information that they want to convey as well as emotions that can heat up if provoked by the user.

This is not what AI was originally supposed to do. The characters in the simulations can't solve problems and they can't understand spoken words, nor can they do symbolic math, solve logic problems, or even play chess.

But the traditional view of AI has never been translated into commercial success, as Schank well knows. In the late 1970s, he and his graduate students at Yale University built a computer program called FRUMP (Fast Reading and Understanding Memory Pro-

gram), which integrated the information from the daily newswires into a large knowledge bank. If you asked FRUMP if Secretary of State Cyrus Vance's wife ever met the wife of Israeli Prime Minister Menachem Begin, the program would assume, correctly in this case, that she had, since both Vance and Begin had attended a state dinner and had probably taken their wives.

As potentially useful as such a program might seem, problems started for Schank when, like many AI researchers around the country, he tried to turn AI into big business. In 1981, Schank created Cognitive Systems to develop a commercial version of his program. "I had this technology that could do FRUMP, but I didn't understand the word 'product,'" he says. "I thought businesses would come in and tell us what to do with it. This was a total fantasy."

The following year, however, Schank started a second company called CompuTeach. His children were having problems in school—they were bored, just like he had been. So when a friend suggested that he try to help them by writing educational software, he created a number of basic packages designed to help kids learn to read and do arithmetic.

While developing the CompuTeach software, which contained none of his AI programming techniques, Schank

nonetheless realized that some of the AI theories he had pursued could be applied to education. Instead of teaching a computer how to learn, he reasoned, he would use computers to teach people how to learn. Thus when an opportunity to develop educational AI software arose one day in 1989 during a chance meeting between Schank and some high-placed executives at the Arthur Andersen Worldwide Organization, the world's largest computer consulting company, Schank went for it.

Schank learned that Andersen, a graduate of Northwestern University and a member of its board of directors, sought to accomplish two goals. He desperately wanted to bolster Northwestern's lackluster reputation in computer science as well as improve his company's employee training methods, which were costing some \$200 million per year. Aiming to kill both birds with one stone, Schank proposed that Andersen fund a long-term project at Northwestern that would use AI to create computerized training systems, and then save money by deploying the results of the research within Andersen itself.

Andersen bought the plan, and within the space of a few months the Institute for the Learning Sciences was born. With more than \$3.5 million a year in corporate funding, including a 10-year, \$20 million grant from Andersen's consulting division, ILS employs more than 150 researchers to develop AI-based computer simulations.

ILS simulation designers use a technique pioneered by Schank called case-based reasoning. This approach to AI represents a radical departure from the more familiar rule-based systems. In these, a computer is given a series of "if-then" rules that it applies to a given set of conditions to reach a logical conclusion. For example, a medical diagnostic program might use such rules to deduce a patient's illness from a given combination of symptoms: if a person has the signs of an upper respiratory infection, the computer would sort through all possible illnesses that cause these symptoms and reach that diagnosis.



PHOTO CONTEST

Attempts to devise a clever solution to a problem can yield not only answers but also the distinct pleasures associated with creativity. Thus during this year's photo contest, **"In Search of Ingenuity,"**

Technology Review hopes to receive images capturing some of the resourceful techniques people use as well as the emotions they experience as they invent.



Technology Review will be pleased to publish the winning photographs and award prizes of **\$500, \$300, and \$200** to the first-, second-, and third-place winners.

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Good luck!

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Conversely, rather than asking the computer to solve a problem, case-based reasoning gives users the information they need at the time they need it to reach their own conclusions, an approach that Schank believes is vital to effective learning. In ILS simulations, such information is in the form of hundreds if not thousands of video clips of experts telling stories about the numerous aspects of a particular subject. A program developer, or "knowledge engineer," goes through the clips, or "cases," and classifies their content—sort of like looking for the moral of each story—and indexes them accordingly in a huge database.

The trick is to label the expert's experience in terms of the novice's task and likely vocabulary so that the appropriate clip or clips will pop up at the right point

in the simulation. That way, in a program to help medical students learn the art of diagnosis, for example, the computer could interrupt the doctor-patient interview when the student fails to ask a vital question about a cough. The expert might pop up and tell a story about the time he or she did the same thing and failed to recognize that the patient had an allergic condition.

Learning from Experience

One of the ILS's first such case-based systems was TransAsk, a database designed to teach novice military officers the principles of transportation planning and execution. To build the system, ILS researchers filmed 33 military transportation experts describing what they knew about moving equipment and personnel around the army and throughout the world. The researchers then distilled this database down to 21 hours of concrete advice. "We worked on it for about a year and a half," says Ray Bareiss, ILS's assistant director of research.

Other systems include the North West Water Customer Service Application, developed to help North West Water train its new employees, and ASK North West Water, an information kiosk that lets customers ask executives of the private utility questions ranging from "What does the water utility do?" to more thorny ones such as "Why isn't water free?" and "Why are the utility's director's paid so much money?"

Museum-goers in the United States can get their hands on an ILS system in an exhibit about sickle cell anemia at Chicago's Museum of Science and Industry. Walk by the exhibit, and the computer might call out, "Help me out here, will you?" When you sit down, you'll be confronted by an African-American couple. The husband, LeRon (played by a professional actor), has sickle cell anemia, and the couple wants to know if their children will suffer from the disease. Playing the role of genetics counselor, you can ask the couple questions, order laboratory tests, and then inform the pair of the results. Tell LeRon

something that doesn't make sense, and he gets argumentative and upset. The only way to repair your relationship with him is to consult a few experts and tell him the facts.

Sickle Cell Counselor has three different sets of couples, each with a unique family genetic history, and not just the simulated families but also the exhibit's visitors want to know if the children will have the disease. "People are very interested in finishing the exhibit because they are curious about the outcome," says Barry Aprison, project director at the museum. "That's quite a feat since most science museums are so crowded with neat stuff, that visitors rarely linger over an exhibit for more than a few seconds."

Most of the institute's work, though, is in building systems that will be used by its corporate sponsors. Ameritech, one of the seven regional telephone companies, asked ILS to build a system that teaches its employees how to sell advertisements in the Yellow Pages. In one scenario, the computer simulates selling an ad to a roofer and his wife. It includes clips that reveal their emotional state, and shows how convinced or annoyed they are by your sales presentation. During the simulation, the roofer asks most of the questions, but every now and then the wife asks something that seems to come out of the blue. Ameritech trainees quickly learn that it's bad business to ignore family members: in this family, as in many, most of the financial decisions are made jointly.

"Teaming with researchers at ILS has led us to a new approach for educating professionals," says Lawrence Silvey, managing director for Andersen Consulting Education. "When employees learn by doing, they learn faster and retain more, and we are able to develop more advanced professional skills in our people." But perhaps what's most compelling about all these systems is that they let people learn from the computer the same way that we learn from each other: by listening to stories. It's the same way that people have been exchanging information for thousands of years.—SIMSON GARFINKEL

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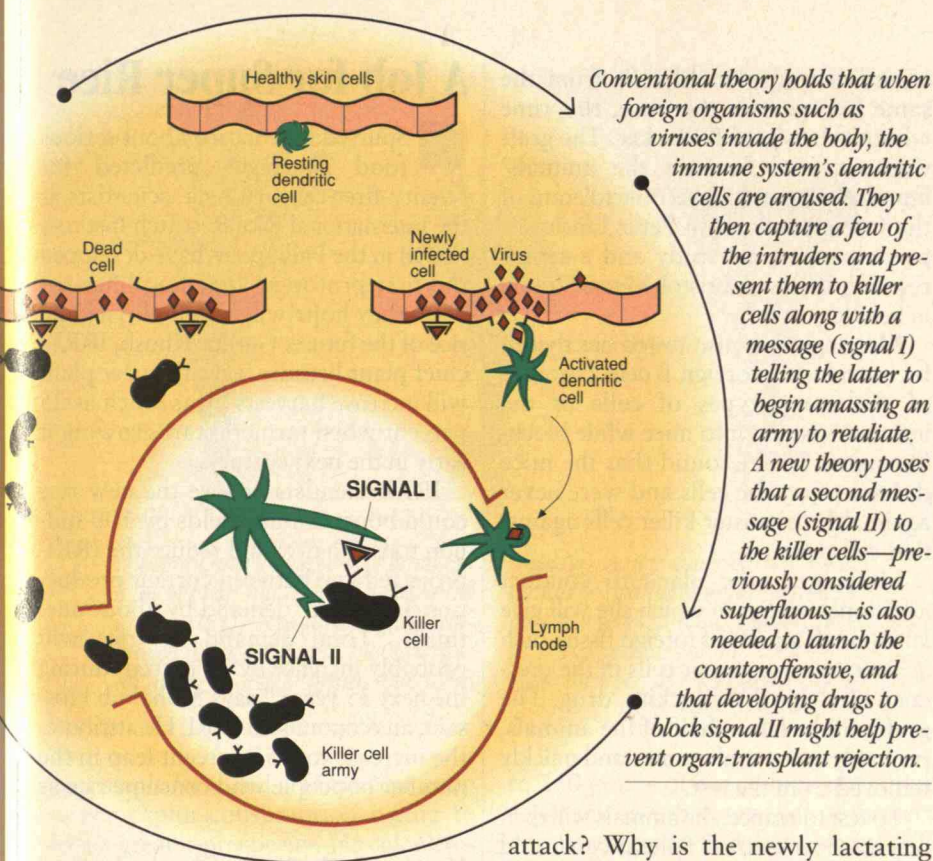
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Controlling the Immune System's Armies

For three-quarters of a century, dogma has held that the immune system avoids attacking the body's own tissues because it learns very early to distinguish self from nonself. Every substance present in the body during a brief window of time during embryonic development is recognized as self. Anything that is new to the body after this time is viewed as an invader and attacked. Peter Medewar, an immunologist, won a Nobel Prize for experiments he performed in 1953 at University College in London that appeared to prove this theory.

Since then, this model has begged about as many questions as it has answered. If tolerance of self is learned so early in life, why do substances that appear at puberty fail to invite immune

attack? Why is the newly lactating breast, which produces unfamiliar milk proteins, spared the wrath of the immune system's killer cells? Why does the immune system fail to attack food and metal or plastic implants?

From time to time, new theories have been proposed to try to account for the exceptions to the rules that researchers have grafted onto the model. Now Polly Matzinger, an immunologist at the National Institutes of Health, has proposed a model that not only does away with all the discrepancies but may also help scientists solve the problem of organ transplant rejection.

What is it that really triggers immune attack? The answer may seem obvious, but Matzinger says it came to her only after several years of thought, and discussions with a young colleague at NIH, Ephraim Fuchs. The immune system responds to danger—"anything that causes cell stress or injury." She speculates that stressed and dying cells release "alarm calls," chemical signals that set off a cascade of reactions that ultimately mobilize an army of killer cells to do bat-

tle against the invading organism.

Scientists have known that the immune system has in reserve an enormous number of killer cells to attack just about any target that a biological system can manufacture, such as the myriad strains of cold, flu, or whatever else might ail a body. Each one is designed to recognize and attack only one specific shape. For example, one type of killer cell can attack only a flu virus while another can attack only a polio virus.

Vital Signal

Each type of killer cell is normally present in all of us from birth in very small numbers. But when sickness strikes, the appropriate killer cells divide and subdivide, creating an army to attack the invader.

Immunologists originally assumed that the simple recognition of a foreign invader was enough to trigger army building. But some 25 years ago, scientists postulated that a second impetus, or signal, which they dubbed signal II, was necessary. Since then researchers discovered that signal II does indeed exist and that it is sent to the killer cells from their immune system colleagues, the dendritic cells, which reside quiescently in every tissue until activated by the foreign invader.

At that point the dendritic cells wake up, sample their environment for whatever debris might be about, and make their way to a nearby lymph node, where they present their samplings to the wandering killer cells. During the process of presenting this protoplasm to the killer cells, signal II is sent, researchers think, as protein molecules normally residing in the membranes of the dendritic cells rise to the surface and lock onto special receptors on the surface of the killer cells.

According to conventional theory, signal II wasn't necessary for the killer cells to begin amassing their troops; only the simple perception of a foreign invader was important. But Matzinger thinks the dendritic cells are activated only when their surrounding tissues are stressed or

injured and that signal II serves the critical role of telling the killer cells that the foreign protoplasm is dangerous. And that—rather than the simple perception of a foreign invader (signal I)—is the initial impetus for army building. Moreover, she theorizes, killer cells simply die if they do not receive signal II after receiving signal I. And this process, rather than a special embryonic period of learning to distinguish self from non-self, is what eliminates killer cells that might attack one's own tissues.

Safer Organ Transplants

It follows, Matzinger suggests, that blocking signal II during and after a human organ transplant could prevent rejection. Today transplant patients take a drug, cyclosporin, that prevents immune destruction of the new organ by blocking signal I. They must take this drug for the rest of their lives because rather than causing destruction of the killer cells that target the new organ, it merely inhibits their ability to recognize foreign tissue. That, in turn, causes a general dampening of the immune response, which leaves the patient more susceptible to all manner of illness.

Like cyclosporin, a signal II blocker would dampen immune response to any illness, not just to the transplanted organ. But a signal II blocker would have to be taken for only a month or so, rather than for life, Matzinger says. That's because as the body heals and the trauma of transplantation subsides, the tissue would stop sending alarm calls. Consequently, the dendritic cells would cease their broadcasts of signal II, and the killer cells targeting the new organ would quickly be depleted.

Other researchers have already provided support for Matzinger's theory. For instance, last year researchers transplanted a graft of human pancreatic cells into mice in the presence of a drug that interfered with the molecular binding of the dendritic cells and the killer cells, thus blocking signal II. The drug was administered for one week, and the graft was accepted. Several months later, the

scientists transplanted cells from the same lineage into the mice, this time without the signal II blocker. The graft was accepted because the animals' immune systems had become tolerant of the foreign cells, says Peter Linsley, a participant in the study and a senior research fellow at Bristol-Myers Squibb in Seattle.

Matzinger has also tested her theory by introducing foreign B cells (another of the many types of cells of the immune system) into mice while blocking signal II. She found that the mice did not reject the cells and were never again able to muster killer cells against that cell type.

Matzinger now plans to conduct additional studies in which she will give lab animals a graft of foreign tissue such as liver, skin, or tumor cells in the presence of a signal II blocking drug. The graft will be left in half of the animals, probably for several months and quickly removed from the rest.

To test tolerance, the animals will then receive new grafts. Tolerance should develop in those animals with the original graft, as the killer cells specific for that tissue will have all homed in on it only to die off in the absence of signal II. But those animals from which the graft is removed will not have used up their supply of graft-specific killer cells and will thus attack and reject the new tissue.

Matzinger says that experiments using signal-II blocking drugs during human organ transplants may be several years away. The biggest technical obstacles, she notes, are ignorance of the chemical structure of the alarm signals that the dendritic cells receive, and of the numerous signal IIs that probably exist in humans.

For example, there may be several types of signal II molecules in human dendritic cells and there may be several types of danger signals that these cells receive from stressed and dying tissues, and blockers might be needed for several or all of them. In fact, at least two signal II-type molecules have already been found in the membranes of human dendritic cells.—DAVID HOLZMAN

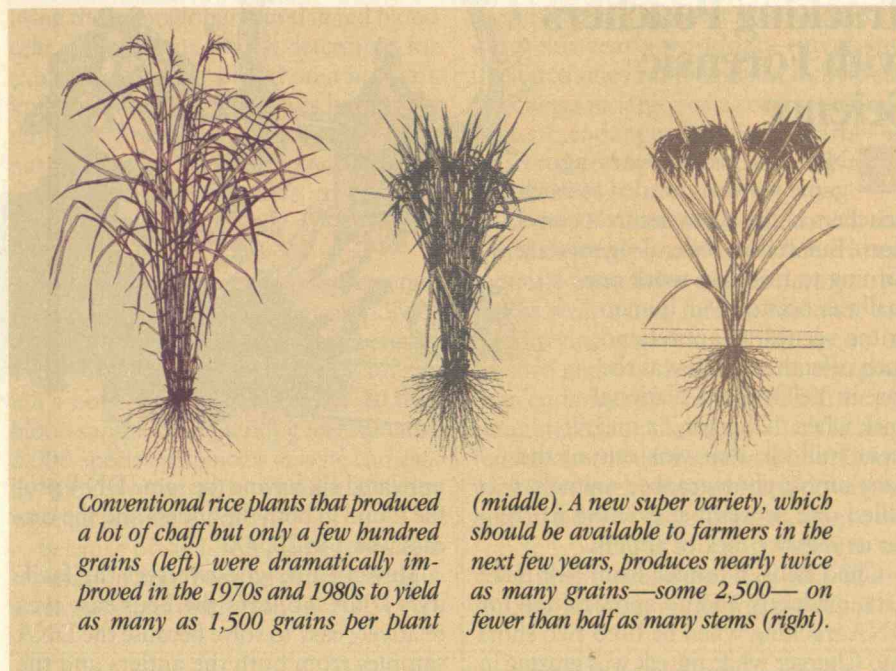
A Job for Super Rice

Spurred by concern about serious food shortages predicted for twenty-first-century Asia, scientists at the International Rice Research Institute (IRRI) in the Philippines have developed the first prototype breeding lines for what they hope will be a high-yielding rice of the future. Gurdev Khush, IRRI's chief plant breeder, says the new plant will increase harvests by as much as 25 percent when farmers start growing it early in the next century.

IRRI scientists believe the new rice could boost annual yields by 100 million tons. That would reduce the IRRI-projected gap between current production and future demand by about one-third. "Total demand for rice will probably increase by 70 percent during the next 35 years," says Mahabub Hossain, an economist at IRRI. He attributes the increase to a 55 percent leap in the number of people who consume rice as

Plant breeder Gurdev Khush has developed a high-yielding rice that promises to produce nearly a third of the 350 extra tons of grain needed annually to feed Asia by 2025.





Conventional rice plants that produced a lot of chaff but only a few hundred grains (left) were dramatically improved in the 1970s and 1980s to yield as many as 1,500 grains per plant

(middle). A new super variety, which should be available to farmers in the next few years, produces nearly twice as many grains—some 2,500—on fewer than half as many stems (right).

their staple food and a 15 percent jump in per capita consumption owing to Asia's greater prosperity. He calculates that 350 million tons more rice will have to be produced every year by 2025.

As industry claims more land, water, and labor from agriculture and environmentalists apply more pressure to reduce the use of chemical fertilizers and pesticides, growing rice—and especially growing more of it—is becoming more problematic. "Our biggest challenge," says Philippine President Fidel Ramos, an IRRI supporter, "is figuring out how to produce more rice on less land—and how to do this with less water, less rural labor, and, above all, less of the pesticides that pollute our streams, rivers, and lakes."

IRRI scientists believe they have found at least a partial solution by cross pollinating the highest-yielding varieties IRRI created during the first Green Revolution over several generations totaling five years. Compared with IRRI's existing high-yielding rice varieties, the resulting "super rice" appears far less bushy—each plant consists of only about 10 stems compared with 20 to 25. But all of the stems contain seed pods bearing 200

to 250 grains of rice, while only about 15 stems on other varieties of modern rice carry pods that bear about 100 grains. Thus, a single super rice plant will produce up to 2,500 grains of rice compared with a maximum of 1,500 grains from today's varieties.

According to Khush, the super rice is also a more efficient plant. Thick, dark green, and erect leaves catch more sunlight, boosting per-leaf photosynthesis by 15 percent. Because the plant makes more grain and less chaff, it produces more food per unit of fertilizer. And fewer excess stems mean farmers can grow plants closer together, increasing paddy yield.

Despite the new strain's promise, some rice specialists are skeptical. They worry that it will perform poorly in less-than-optimal conditions, especially considering that super rice, like earlier high-yielding varieties, requires abundant irrigation to achieve greater yields.

Even IRRI's own Hossain suggests that more attention should be focused on nonirrigated areas, where poverty and food insecurity are greatest. "Look at South Asia, where less than 50 percent of rice land is irrigated," he says. "Look

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at the hills in the Philippines or the Central Highland in Vietnam. Super rice will not help make food available to poor people living in those areas."

Overreliance on Science?

Some critics, such as Nicanor Perlas, head of Manila's Center for Alternative Development Initiatives, believe that IRRI's approach is flawed. In fact, he says, the first Green Revolution's impact on farmers with irrigated fields was less than uniformly positive because of economic issues such as the high costs of fertilizer and transportation, inconsistent yields, and the lack of control over marketing and distribution. "Our own studies of the impact of the Green Revolution on individual farmers show that yields have been declining or that costs have been going up." He believes scientific efforts need to be accompanied by programs directed toward distributing farmlands to peasants and farmworkers, improving agricultural extension, strengthening farmers' involvement in marketing the commodities they produce, and creating employment opportunities for people in rural areas.

IRRI counters that the introduction of high-yielding rice during the Green Revolution not only reduced poverty in irrigated rice-producing communities, it also reduced hunger more broadly by increasing output, generating employment, and encouraging a shift to alternative crops in areas unfavorable to modern rice. The institute further defends its new program on the basis of studies it conducted in the late 1980s showing that a dramatic increase in rice production would be not only necessary for the Asian population at large but also attainable. "Food production will have to double over the next decade," argues Ismail Serageldin, a World Bank vice-president and chair of the Consultative Group on International Agricultural Research, the consortium that manages IRRI's funding. "The challenge is not to produce less, as some environmental groups tell us, but to produce different."

—JAMES B. GOODNO

Tracking Poachers with Forensic Science

Not too many years ago game wardens needed to catch poachers in the act to secure a conviction. But today federal agents are turning to forensics work normally associated with human crime scenes to apprehend such offenders. Such was the case in Yellowstone National Park when "Charger," a magnificent bull elk that was one of the park's most photographed animals, was killed one September evening in 1993 for its massive rack of antlers.

Chad Beus, a hunter from Salt Lake City, evidently had no appreciation for DNA tracking when he fired two shots into Charger while the elk was grazing in an open meadow near the Norris Geyser Basin. Indeed, it took the Federal Bureau of Investigation almost a year to solve the case, and the agency might not have done so if not for the work of researchers at the National Fish and Wildlife Forensics Laboratory in Ashland, Ore.

The lab's role in the case began shortly after Beus took Charger's asymmetrical rack, which featured eight points on one side and seven on the other, to a Salt Lake City taxidermy shop for mounting. The taxidermist thought the antlers resembled Charger's, which were pictured in *The Bugle*, the magazine of the Rocky Mountain Elk Foundation. So he sent them to the forensics lab, where investigators quickly matched DNA from the antlers to DNA taken from Charger's carcass.

"The DNA match was pretty strong evidence that the antlers he brought into the taxidermist were the same antlers from the elk in Yellowstone Park," says Christopher Crofts, an assistant U.S. attorney in Wyoming who prosecuted the case. In fact, Beus pleaded guilty when charged with the crime and confronted with the lab's "conservative" estimate that the probability of two



unrelated elk having the same DNA profile found in both the antlers and the carcass was 1 in 20,000.

Steven Fain, who oversees the facility's DNA lab, says the Beus case was relatively easy to solve because the DNA samples from both the antlers and the carcass were ample and clean. DNA tracking becomes much harder, he says, when blood or tissue samples are badly contaminated by dirt, decaying plant matter, or other substances, or when the samples are too small for analysts to extract usable amounts of DNA.

Novel Techniques

But techniques now being refined at the lab could address these shortcomings. Whereas technicians currently require samples that are about the size of a quarter, Fain has adopted a new procedure commonly used in human forensics to reduce the amount of uncontaminated blood or tissue required for DNA matching by about 99 percent. He takes advantage of an automated DNA-copying technique called polymerase chain reaction, which involves heating DNA to separate its two strands of genetic material, isolating unique sequences, and then mixing them with a special enzyme that causes them to multiply millions of times in just a few hours.

In parallel, Edgard Espinoza, a forensic scientist who heads the lab's criminal investigation section, developed a novel species-identification procedure

using the hemoglobin found in red blood cells. The test can quickly determine, for example, whether blood on a hunter's knife is from a pig he claims he slaughtered or from an elk poached in a national park. The test could also be used in human murders to identify whether blood on a knife or clothing is from a person or an animal.

Key to this work is a mass spectrometer that measures the weight of individual hemoglobin molecules, which varies considerably among species. With the lab's collection of more than 20,000 blood samples representing an estimated 2,000 species, Espinoza says he can easily identify the type of animal from which a sample is drawn.

Because of such techniques the lab's reputation has been growing rapidly since it began operation in 1989. Ac-

cording to lab director Kenneth Goddard, this year's workload—involving illicit activities ranging from individual poachings to large-scale commercialization of endangered-animal parts—is expected to top 1,000 cases, up from 800 in 1994.

As the only forensics laboratory in the world devoted to solving wildlife crimes, requests from other nations are on the rise as well. In one foreign case that the lab is trying to crack, wildlife agents in Mexico and the Caribbean are charging that endangered sea turtles are being slaughtered for their fat, which is then rendered into oil for suntan lotion. Criminologists attempting to track down the perpetrators of such illegal acts have no way to separate and identify the turtle oil when fatty tissues from other animals are thrown into the rendering process and

mixed with other oils such as lanolin. So the lab's challenge, says Goddard, "is to find some unique molecular or DNA characteristic in the oil that links it to the sea turtles."

By providing such high-tech support, the lab gives wildlife officers access to the same forensic tools available to investigators of human crimes, says Amos Eno, executive director of the National Fish and Wildlife Foundation, a private organization that apportions federal funding for wildlife conservation. "Until this laboratory came along, if you needed forensics assistance, you had to go to a state crime lab or an FBI lab." But who's going to work on a wildlife corpse when dozens of human bodies are piled up? he says. "Now there's a full-time, state-of-the-art facility devoted to animals."

—KURT REPANSHEK

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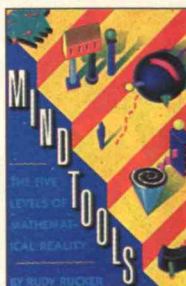
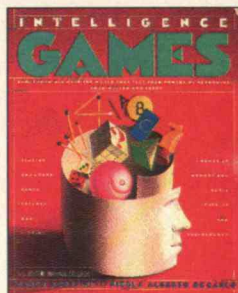
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BY NORMAN BOUCHER

*Nature
built the
River of Grass
one way. Now
humans hope
to replicate it
using their
own very
different
methods.*



THE country's largest wetland is among its most difficult to know. Subtle and elusive, most of the Everglades is thick with mosquitoes and inaccessible without extraordinary effort. From the few roads that enter its fringes, it appears flat and monotonous, all sunshine and sawgrass, which is why many newcomers drive through Everglades National Park and leave disappointed. Lacking mountains, the vistas are undramatic. Visitors notice the abundance of big, colorful birds but are often oblivious to the ecosystem's real significance. 🌿 Hidden in the savannas, hammocks, and forests of this patch of south Florida is an astonishing degree of biodiversity. The Everglades lies at the intersection of the tropical and temperate, making it the only true subtropical wilderness in the United States. Its plants and animals include the tropical mahogany, the temperate slash pine, and unique subtropical species such as the hawklike Everglades snail kite. The area is refuge to 56 plants and animals declared endangered or threatened under the federal Endangered Species Act. 🌿 Adding still more to the Everglades' richness is

Back to the

A photograph of a Florida Everglades landscape at sunset. The foreground is filled with tall, dark green grass. In the middle ground, a line of trees and shrubs is silhouetted against a vibrant orange and pink sky. Several palm trees are prominent, with one particularly tall and slender tree standing out in the center. The overall mood is serene and natural.

Everglades



its fecundity as a wetland that's coastal as well as subtropical. Along its fringes, fresh and salt water mix to produce a kind of primordial soup that at times seems to boil with spawning fish. There is, Marjory Stoneman Douglas wrote in her 1947 classic, *The Everglades: River of Grass*, no other place that combines all these attributes, "no other Everglades in the world . . . one of the unique regions of the earth, remote, never wholly known." Scientists have become so enraptured by it that the Everglades is one of only three sites on earth declared an International Biosphere Reserve, a World Heritage Site, and a Wetland of International Importance. The other two are in Tunisia and Bulgaria.

Yet for all its richness, today's Everglades is also a drastically diminished place. It has been so thoroughly drained and reshaped for the benefit of farms and cities that some biologists regard it as little more than a metaphor for the original biological system. "We once had an ecosystem that we called the Everglades," says

All this has made the Everglades the ideal candidate for the biggest ecosystem recovery project in history, a project aimed at reinstating the hydrological ballet of the original natural system. Besides preventing the seemingly relentless decline of imperiled species, this undertaking would help replenish the permeable Biscayne aquifer, assuring clean, fresh water for the people of south Florida while providing a head against seawater pushing into the aquifer from the coast. The restoration might also help revive the oversaline waters of Florida Bay and renew its role as a nursery for the marine life of the Gulf of Mexico nursery.

Such renewal does not come cheap, however. Restoring this south Florida wilderness, it now seems, will require billions of dollars of mostly public funds, the development of new technologies, and the forging of new political alliances. Its success depends on three formidable technical achievements: gathering information on the plants and animals living in the Everglades;

integrating that information into a rough but useful description of how the entire ecosystem works; and developing a management scheme that, while clearly articulating specific restoration

Faced with an ecosystem constantly out of equilibrium, managers have tended to react simplistically to crisis after crisis.



John Ogden, a National Park Service biologist who has studied the region for more than 25 years. "Now we have a big wetland out there, and we still call it the Everglades. But it's not. It no longer has the defining characteristics of the original Everglades."

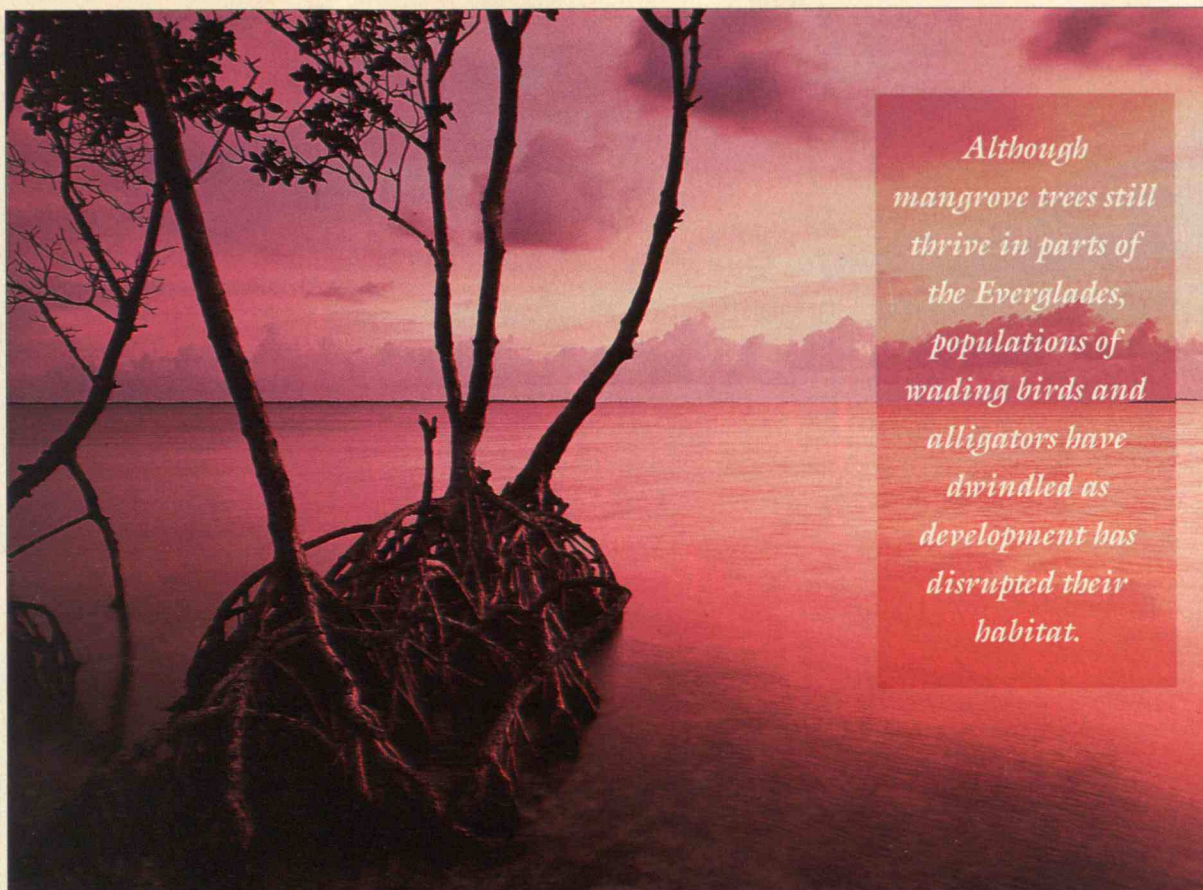
Until this century, the heart of south Florida's landscape was a wet plain 100 miles long and 40 miles wide. Today its area has been cut by half. The rookeries of herons, egrets, and storks in Everglades National Park—colonies that once each contained tens of thousands of birds whose bustling extravagance helped inspire the founding in 1905 of the National Association of Audubon Societies (later the National Audubon Society)—have shrunk by 95 percent since the 1930s. Once-abundant species like the wood stork and Florida panther are now balanced on the edge of extinction.

ation targets, remains flexible and patient enough to adapt to new information and inevitable mistakes.

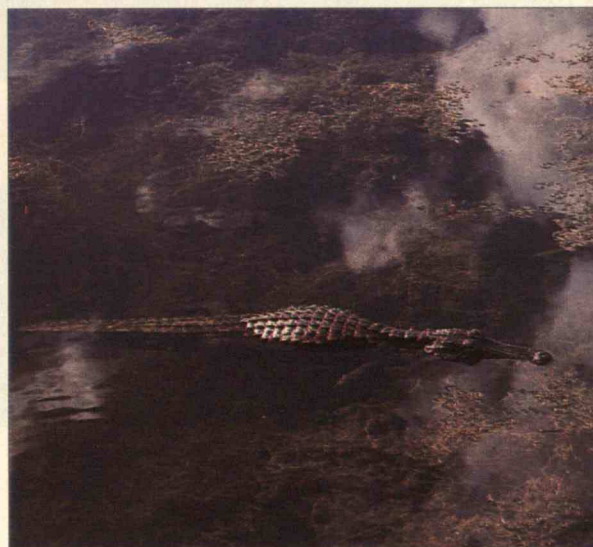
Given its complexity, an ecosystem recovery project this sweeping and this expensive represents a huge environmental gamble. If it fails, the experiment will certainly add to the knowledge of the region's hydrology and ecology, while teaching scientists something about the limits of ecological restoration. But failure will also bring with it accusations of wasted spending in a world of limited government budgets—a result that fills environmentalists with dread.

If it succeeds, Everglades recovery will mean creating a new 18,000-square-mile ecosystem that includes farm and city as well as swamp. For scientists and environmentalists now admit that the Everglades can survive only if reconciled with the lives of the 4 million people who live on farms and in cities along its periphery. Saving the biological system means confining it, for the most part, to this limited area; it cannot expand into the backyards and strip malls of suburban Miami.

NORMAN BOUCHER, a journalist who first visited the Everglades in 1980, has been writing about the area since 1989. His work has appeared in the New York Times Magazine, the Atlantic Monthly, Audubon, and Wilderness. He is currently managing editor of the Brown Alumni Monthly.



Although mangrove trees still thrive in parts of the Everglades, populations of wading birds and alligators have dwindled as development has disrupted their habitat.



Beyond south Florida, success will prove that doing more with less land is biologically feasible—a critical question today in most of the world's wild places. The most compelling argument for the public investment in Everglades recovery is its potential as a model for preserving biodiversity elsewhere, particularly in the rapidly growing list of places where the natural environment is dwarfed by crowded human settlement.

Devising a Plan

Saving the Everglades had long been a popular cause when, in October 1989, a few dozen scientists met in Key Largo, Fla., to discuss whether it could be done. They were optimistic for the first time in years. Even as many of south Florida's wetlands and pine forests were being replaced by theme parks and condominiums, pub-

Big Cypress National Preserve (top) and other Everglades areas share an ecosystem with sugarcane farming (bottom left) and land development (bottom center). The waterworks that make these activities possible—such as the Tamiami Canal (bottom right)—have altered the complex hydrology on which the natural areas depend.



lic interest in ecosystem protection was rising, prompted in part by media reports of scientific concern over the world's shrinking biological diversity. The Everglades Coalition, consisting of almost 30 local and national environmental groups, tirelessly promoted an effort to save the area's unique biological capital. Savvy, well-funded organizations such as the Wilderness Society, the Sierra Club, and the National Audubon Society had either opened offices in south Florida to work toward the cause or had employees spending the bulk of their time on it. As a result, the political will for Everglades conservation in

both Washington and Tallahassee was stronger than ever. And perhaps most important, south Florida scientists believed they now understood the local ecosystem well enough to plan the Everglades' recovery.

The word "recovery" reflects a new, more aggressive attitude toward the preservation of biologically rich landscapes. Early this century, land in the United States was simply set aside, or "conserved"; when that proved insufficient to protect it from politically powerful miners, ranchers, and lumber companies, it was "managed" to balance wildness with the resource needs of a rapidly



expanding human population. Now, as the world's biodiversity continues to decline, scientists are embracing the more ambitious goal of not just stopping but reversing the degradation of ecosystems, of returning them to a state that averts the extinction of their native flora and fauna.

Although ecosystem recovery in a landscape as large and baroque as the Everglades is unprecedented, scientists at the 1989 symposium were beginning to understand that enough data had been amassed to attempt it. "The symposium revealed that more was known than we realized," says Steven Davis, one of its organizers and a senior ecologist at the South Florida Water Management District (SFWMD). The participants concluded, for example, that computer modeling of the south Florida landscape was finally advanced enough to allow them to recreate all the essential characteristics of the wild system within today's developed landscape.

The scientists emphasized three important traits. The first—and least restorable in today's urbanized south Florida—was its vast area, which provided a place for animals, like the Florida panther, that require a large home range. Although scientists are unsure about how much space the ecosystem needs to function well, it must be large enough to accommodate the second essential characteristic: a continuously changing hydrology. This landscape of fluctuating water depths supplied abundant food somewhere in the system for wildlife during every season, and produced the third characteristic, namely a pattern of highly varied, patchy habitats. Together, these habitats furnished an ecological niche even for animals with unusually specialized needs, such as two endangered birds, the snail kite and the Cape Sable sparrow.

The difficulty lies in determining how to engineer those characteristics back into the system. Past experience, which consists of decades of efforts aimed at saving bits and pieces of the ecosystem without addressing the needs of the whole, is mostly a lesson in what not to do. Many environmentalists, despite their advocacy of systemwide restoration, were at first skeptical that it could ever be accomplished. Their concern arose because the restoration blueprint is being assembled, ironically, by the U.S. Army Corps of Engineers, which,

at the behest of the local governments, completed in the 1960s the flood-control works causing the current decline. But with ecological guidance from such agencies as the SFWMD, the National Park Service, the U.S. Fish and Wildlife Service, the National Biological Service, and the National Marine Fisheries Service, today's "greener" Corps is in south Florida attempting to reform itself from the country's premier dam builder and filler of wetlands to its most eager student of environmental reconstruction. In December, the agency issued a half-dozen possible restoration plans, from a \$5 million tampering with the operation of the existing canals and pumps to a \$2 billion reconfiguration of the landscape. (See "Six Ways to Save the Everglades" on page 32.)



The Everglades can survive only if reconciled with the lives of the 4 million people who live on farms and in cities along its periphery.

Life Out of Balance

Scientists have long had a general understanding of the conditions that once supported the Everglades. For much of the year this sawgrass river and most of the teardrop-shaped islands of trees along it were covered with a few inches of fresh water, the result of an average annual rainfall of about 55 inches, 70 percent of which arrives in almost daily downpours from May through October, the area's wet season.

All this water moved south in an expansive sheet and eventually fed Florida Bay, an important marine hatchery and the site of a rare North American coral reef. Even today, a wet Everglades functions like a huge solar collector, manufacturing an algal mix known as periphyton and then slowly releasing the energy up the food chain throughout the rest of the year. During the wet months, water percolates through the peaty soil into the Biscayne aquifer, the limestone formation underlying the ecosystem that supplies the wells of Miami and other east coast Florida cities. As this fresh water moves through the Everglades, the system's nutrient-starved plants remove some of its pollutants; as the now-filtered water settles into the Biscayne aquifer, its sheer volume



exerts enough pressure to keep the saltwater offshore from seeping in.

Historically, the seasonal ebb and flow of water produced tens of thousands of expanding and shrinking pools that formed a marshy mix of habitats in constant flux. "With its large size and remarkable habitat complexity," says the National Park Service's Ogden, "the Everglades provided habitat options under any conditions. If the place where a species

was feeding no longer worked, there were probably places in the system that did work." He adds, "That's no longer true."

The settlement of south Florida and the construction of civil works to protect settled areas from flooding have altered this complex choreography. From the beginning of this century through the 1950s, developers and other entrepreneurs drained water from as much Florida land as they could sell for farms and houses. And ever since the early 1960s, when the Corps of Engineers completed

the Central and Southern

Florida Flood Control Project, the area's fresh water has been shunted through 1,400 miles of canals and levees, 150 gates and spillways, and 16 of the world's largest pumping stations. The ever-shifting patterns of the original flow have been reduced to a uniform and monotonous "schedule of water deliveries" designed to produce the predictability necessary for large-scale agriculture and for suburbs that don't periodically revert to swamps. But altering the hydrology has profoundly affected the ecology—for example, by forcing colonies of birds to abandon their traditional nesting sites.

By quickly sending water to the sea during the wet months, the schedule has reduced the amount that

lingers in the Everglades into the dry season. This has often resulted in unnaturally parched winters and fewer wet areas to serve as refuges for the fish that are "released" by the wet season rains to supply food throughout the ecosystem. Less water also means a smaller head exerting pressure against seawater, which in turn has resulted in a diminished Biscayne aquifer and the closing of some wells due to salinity. Finally, because most of the water drained off land after heavy rains is rushed east and west to sea, less of it reaches Florida Bay. This, scientists increasingly believe, may be contributing to a massive die-off of sea grass, which provides food and shelter for a number of unique species.

Faced with an ecosystem constantly out of equilibrium, and lacking any real master plan, managers have tended to react simplistically to crisis after crisis. In 1962, for example, when several years of drought followed completion of the Corps's flood control project, the combination so reduced water flows that managers at Everglades National Park dynamited holes in the limestone to create pools for alligators, which were disappearing from the ecosystem. When the park superintendent begged for more water, Congress mandated monthly "minimum deliveries." But this simplistic "just add water" approach drowned out alligator nests with surges of ill-timed water, which was contaminated with phosphorus after being quickly drained from sugar fields after a prolonged rain. Even a revised delivery schedule that coordinated water pulses more closely with periods of rain produced only minimal ecological gains; the new arrangement did not sufficiently take into account the smaller size—and hence lower storage capacity—of the modern ecosystem.

Reconstructing the Past

Because water is the foundation of the Everglades, many of the recent ecological ills stem from disruptions in its timing, flow, quality, and abundance. Accordingly, the most powerful tool in planning the restoration is a computer program that mimics the Everglades' original hydrological patterns. Known as the Natural System Model (NSM), it was developed in 1989 specifically for the restoration project. The NSM is based on an earlier model that guides the decisions of south Florida water managers about which pumps to activate and which gates to open or close in order to direct water where they want it. Because its simulations for a given day can be compared with what actually happens, the

Scientists now dare to predict that tomorrow's flowways and canals will sustain the region's hydrology as effectively as sawgrass and pond apple once did.



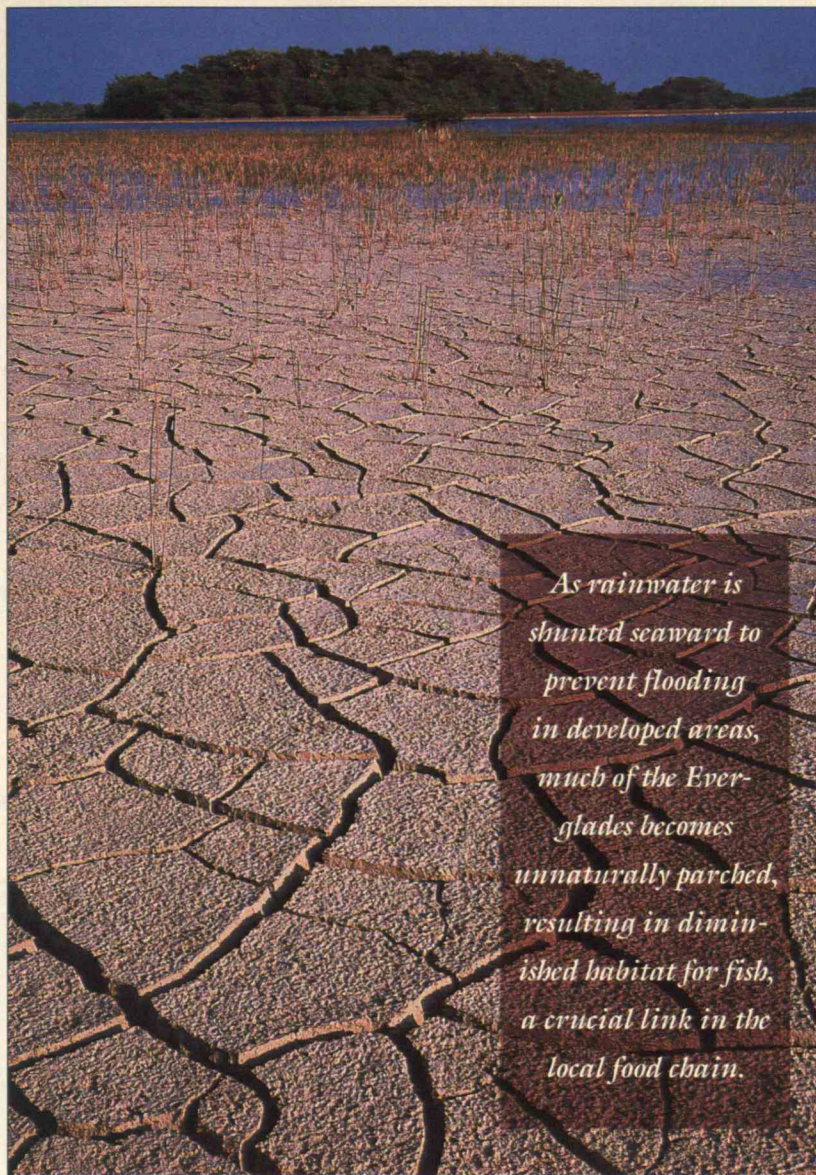
NSM's designers can easily verify its effectiveness: if the model is right, farms and cities prosper, and if it's wrong, crops are ruined and homes flooded.

When public pressure in the late 1980s pushed thinking toward wholesale restoration, Thomas MacVicar, who was then an engineer with SFWMD, modified the water management model to simulate how water would flow through today's remaining wild landscape if all the pumps, gates, and other water control devices had never been built. But because no one was around to record water data in presettlement days, the NSM's algorithms cannot be calibrated and verified against reality. This means the model must be used more as a sketch pad than as a blueprint for restoration: it can perhaps recreate the original system precisely enough to reveal its defining characteristics, but not so precisely that scientists are tempted to restore the Everglades acre by acre.

Using the model, researchers have examined long-held assumptions about the Everglades and tested new ones. Scientists long knew, for example, that during wet years water once spilled over the southern rim of Lake Okeechobee to the north and onto the Everglades' richest soils. Now, though, more than 500,000 acres of this rich black peat support enormous sugar cane and vegetable farms. To protect them from flooding, the Corps of Engineers diked the southern rim of Okeechobee, cutting the remaining natural Everglades off from an important source of its lifeblood.

Scientists were uncertain about the volume, timing, and direction of that water. How much of it spilled into the Everglades from Lake Okeechobee, and how often? How much of it did the northern portions of the landscape absorb and how much passed through to the rest of the Everglades? To what extent did friction from a half-million acres of sawgrass slow the water down? How important was Okeechobee overflow in keeping Florida Bay at just the right salinity to maintain its remarkable fertility? Without accurate answers to questions like these, scientists cannot know how much water to ask for, or where and on what schedule it should be delivered.

The problem was not merely imagining the farms



As rainwater is shunted seaward to prevent flooding in developed areas, much of the Everglades becomes unnaturally parched, resulting in diminished habitat for fish, a crucial link in the local food chain.

converted back to sawgrass and pond apple. Exposing soil long covered by water greatly speeds up its breakdown into dust by microorganisms—in some parts of the Everglades agriculture region as much as four feet of soil has been lost this century. By asking the NSM what would happen if 500,000 acres of northern Everglades farmland regained its lost soil and reverted to sawgrass, scientists have learned that the area served as a massive storage vessel. The National Park Service's Ogden explains that rainwater lingered there for months, combining during wet years with an undetermined amount of Okeechobee overflow. Then, like a saturated kitchen sponge, the soil released the water slowly over more months than Ogden and his colleagues had earlier believed.

This delayed flow explains the disappointing results of tying water releases into the Everglades directly to

Six Ways

In December 1994, the U.S. Army Corps of Engineers completed its reconnaissance study for comprehensive restoration of the Everglades. It presents six alternative plans for reconciling south Florida's natural and developed landscapes. Except for Plan 1, the alternatives do one or more of three things: 1) draw more water from Lake Okeechobee and design ways of conveying it "naturally" south to the Everglades; 2) create more water-storage capacity in the system, allowing water to be slowly released over a larger part of the year; and 3) reconnect the sections of the natural system that have been fragmented and isolated from one another by flood-control levees and canals. The next step in the restoration process is for the Corps to choose a plan and conduct an environmental impact statement.

PLAN 1 would require no changes in the 1,400 miles of water delivery structures now crisscrossing south Florida. Instead, scientists and engineers would develop a new operational schedule using the existing structures in an effort to manage flows in a way that balances ecosystem and human needs. Because it requires taking no agricultural land, this plan would cause the least economic disruption. Cost: \$5 million.

PLAN 2 calls for widening the canals that now run through the Everglades Agricultural Area to increase the amount of water flowing from Lake Okeechobee to the remnant

South Florida

- South Florida Water Conservation Areas (WCAs)
- Federal Lands
- Everglades Agricultural Area
- Canals and Channels
- Wetlands (marsh, cypress swamp, mangrove)

Original Everglades



Everglades Today



Left: In this century, the Everglades has shrunk to half its original size. Above: Today, restoration efforts must attempt to unify a patchwork of Water Conservation Areas, farm and urban areas, and parks.



to Save the Everglades

Everglades to the south. A new levee would be built to protect the Miccosukee Indian Reservation from flooding. Water Preserve Areas would also be created east of the Everglades to store the additional water, replenish the Biscayne aquifer, and provide critical short-hydroperiod marshes. The plan would require that the Corps of Engineers remove 58 miles of existing water barriers and buying or taking between 35,000 and 78,000 acres of agricultural land. Cost: \$1.2 billion to \$1.5 billion.

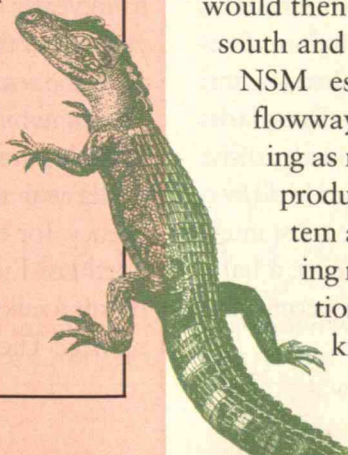
PLAN 3 would include the increased Lake Okeechobee flows and preserve areas of Plan 2, with the added goal of reducing the ecological fragmentation created by south Florida's water management system. Levees and canals would be removed from the three Water Conservation Areas (WCAs) north of Everglades National Park. This reintegration would allow water to flow through the Water Conservation Areas in the "sheet flow" pattern that characterized the presettlement Everglades. Plan 3 requires removing from 71 to 117 miles of canals and levees and taking or buying about 35,000 acres of agricultural land. Cost: \$1.27 billion to \$1.35 billion.

PLAN 4, like Plan 2, requires a greater flow of water south from Lake Okeechobee and creation of Water Preserve Areas to store it. But instead of widened canals, this alternative calls for building flowways either one or three miles wide

through the Everglades Agricultural Area. This would create greater sheet flow and more storage capacity in the system, but would not alter the fragmentation of the Water Conservation Areas. The plan calls for dismantling 58 miles of water barriers and removing between 54,000 and 85,000 acres from agricultural production. Cost: \$1.3 billion to \$1.55 billion.

PLAN 5 combines the flowways and Water Preserve Areas of Plan 4 with Plan 3's restoration of connectivity among the Water Conservation Areas and Everglades National Park. It requires removing 105 miles of canals and levees and taking or buying 55,000 acres of agricultural land. Cost: \$1.7 billion.

PLAN 6, the most ambitious and costly option, would create a huge flowway, 7 to 13 miles wide, through the Water Conservation Areas to reconnect them and provide for maximum flow and storage. All levees within the Everglades Agricultural Area would be taken down to ground level. The Water Preserve Areas called for in the other plans would be greatly expanded, forming a continuous buffer between the natural Everglades and the developed portions of south Florida. The plan would require removing 117 miles of canals and levees and taking 167,700 acres out of agricultural production. Cost: \$2 billion.



rainfall patterns, which tends to introduce the water too soon to the southern ecosystem, throwing off such critically timed events as alligator and wading-bird nesting cycles. It also means that because more water was around later into the dry season, more was available all year to the Biscayne aquifer and, by extension, to city faucets. Environmentalists have seized upon this link between natural and urban landscapes to argue that the restoration need not be at odds with the requirements of Miami and Palm Beach. Similarly, water slowly released from the northern Everglades in the dry season allowed more fresh water to reach Florida Bay over a longer period, helping to keep its salinity in check; this in turn makes restoration advantageous to the commercial and sports fishing industries dependent on the Gulf of Mexico.

The NSM has also helped scientists understand gaps in the ecosystem's range of habitats. In the early dry season, for example, wetlands east of today's Everglades were the perfect depth to serve as the main feeding area for hundreds of thousands of wading birds fattening up for breeding. Many biologists now theorize that the loss of 80 percent of these wetlands may have been the trigger for the birds' departure from the southern Everglades.

This kind of detailed information and analysis gives south Florida scientists and resource managers a focus for their management strategy. By quantifying the arrangement of the original system, the NSM allows them to think about where in the current landscape they might recreate its essential components. If restoration means more water slowly released from the north, the overarching question becomes, Where can that water be found today and how can it be delivered?

All but one of the Corps's six alternatives for restoration call for pumping water from Lake Okeechobee and sending it through the northern Everglades agricultural district either in widened canals or in huge widened marshes known as "flowways." The water would then be stored in secondary wetlands farther south and pumped along at a rate in keeping with NSM estimates. But obtaining and building flowways one to three miles wide would mean taking as much as 167,000 acres out of agricultural production. Beyond that, storing water in a system already reduced by half may require buying many more acres of developed land, a solution that can get prohibitively expensive. This kind of impact requires winning over federal,

state, and local officials as well as the owners of these lands—who have long had political influence at every level of government. So far, though, environmentalists have been extraordinarily successful at fueling popular support for Everglades restoration. The project is a favorite of Secretary of the Interior Bruce Babbitt, who regularly travels to Florida to address Everglades Coalition annual meetings, and the sugar industry's recent agreement to reduce phosphorus contamination of its runoff indicates that even this long-resistant economic player is beginning to understand the importance of a healthy regional ecosystem.

Thanks to the NSM, what was a few years ago a romantic wish for a healthy Everglades is fast becoming a work in progress. The model has emboldened scientists to envision a natural Everglades ecosystem coexisting with today's developed south Florida landscape. They can do little to regain the spatial extent of the presettlement Everglades, of course. But they now dare to predict that flowways and canals will prove just as effective in sustaining dynamic hydrology as the untouched plain of sawgrass and pond apple they are designed to replace.

Getting to Work

The biggest challenge now facing the Corps of Engineers and its partner agencies is how to implement the knowledge they have lately gained. Choosing among the several plans the Corps unveiled in December is the next step, requiring a series of public hearings and more analysis. Then comes the engineering of the final project, the acquisition of real estate, the construction of control structures and new canals, and, finally, the operating and monitoring of the new system. When all this is finished—sometime early next century, scientists hope—Everglades restoration will have become one of the most expensive environmental projects ever undertaken. And in all likelihood, the Everglades will have become the most intensively studied and manipulated ecosystem ever, a natural world sustained, strangely enough, by computer programmers and civil engineers.

The wildernesses of the twenty-first century could very well be engineered ones.



Indeed, 71 computer models that are either finished or under development will supplement the basic hydrological information of the NSM. Many of them, constructed by scientists at agencies such as the SFWMD, the National Park Service, the National Biological Survey, and the Corps of Engineers, are aimed at corroborating a major assumption behind restoration: that recreating the hydrology will recreate the ecology. The SFWMD, for example, is developing an Everglades Landscape Model that will describe how vegetation would react to a particular hydrological pattern. These results, in turn, can be plugged into a wide range of ecological models that predict the effect of hydrological and landscape changes on communities of animals.

Ecological modeling is even more difficult than the hydrological kind. "Man and God agreed long ago on what happens when water runs up against a levee," says Jonathan

Moulding, an ecologist with the Corps of Engineers. "No one knows for sure what's going to happen when a wood stork flies off the nest in the morning to look for food." Scientists are aware that these models, and the practical measures they will inspire, will need a great deal of adjustment over the long run.

Because of this, the Corps proposes to make whatever plumbing changes are necessary for Everglades restoration in two-year stages. That way, hydrologists can monitor the results to make sure the water distribution is on track before the next phase of restoration begins. But because the biological patterns resulting from this new hydrology can take a decade or more to distinguish from yearly anomalies, biologists would like to see five-year rather than two-year increments. The difference has yet to be resolved.

Meanwhile, the Corps and the SFWMD have begun to incorporate smaller environmental projects already under way into broader restoration goals. The water agency, for example, has acquired huge marshes in the northern Everglades and is flooding them with farm runoff to allow the marsh vegetation to absorb the phosphorus. The Corps is slowly buying up over 100,000

acres of land just east of Everglades National Park to expand Shark River Slough, a huge, deep swath of water that once supplied most of the park and served as an important late-winter refuge for wildlife. Farther south, along the smaller Taylor Slough, the Corps is constructing a feeder canal to reintroduce sheet flow into the area, which is an important source of freshwater to Florida Bay.

In the end, technical uncertainties may be less of a threat to restoration than bureaucratic ones: large government agencies are governed by political appointees, whose commitment to environmental projects tends to fluctuate with the political mood of the moment. Today's congressional emphasis on making environmental regulations more responsive to their economic consequences, for example, could hamper the Corps's efforts to buy land for huge flowways if the effect is a net loss of south Florida agricultural jobs. "The real question behind Everglades restoration," says Crawford Holling, an ecologist at the University of Florida, "is whether institutions and people have the same flexibility as the ecosystem to do the job." The emphasis on computer modeling, for example, tends to make upper-level policy officials more dependent on technical staff to determine what needs to be done. Some have already resisted. Staffers at the National Park Service, the SFWMD, and the Corps of Engineers all say privately that publication of *Everglades: The Ecosystem and Its Restoration*—a collection of papers from the 1989 symposium edited by SFWMD's Davis and the National Park Services' Ogden—was held up for months while a new superintendent at Everglades National Park pondered whether the information it contained about past mismanagement could tarnish the image of the Park Service.

Yet there are also hopeful signs. Appointments to the SFWMD governing board by Florida Governor Lawton Chiles have shifted the balance of power from agricultural representatives to more conservation-minded figures, who are insisting that the needs of the Everglades

be better integrated into local water management. Interior Secretary Bruce Babbitt, meanwhile, has succeeded in obtaining yearly appropriations earmarked exclusively for Everglades projects and has organized a high-level coordinating committee among federal agencies with a stake in south Florida restoration. An interagency science committee has also been issuing technical

recommendations about everything from computer modeling to remote sensing.

Its reports are already key documents for guiding the Corps's evaluation of restoration scenarios.

All this activity obscures an important paradox at the heart of the current Everglades restoration. Like much environmental engineering in the late twentieth century, the project manages to be both grandiose and modest. From one perspective, it appears to be an act of sheer hubris—

yet another assertion that American technical facility can revive something as complex, mysterious, and diminished as this unique wetland. From another, it's merely an attempt to reverse the slow decline of a small piece of a once vast wilderness, to confront the uneasy truth that ecosystems need to make their peace with the developed world threatening to consume them.

The wildernesses of the twenty-first century could very well be engineered ones. No one, for example, believes that the Everglades of 50 years from now will be the wide, splendid river of grass that once supported Seminole and Miccosukee tribes, or the forbidding wilderness whose biting insects, venomous snakes, and carnivorous reptiles meant refuge for escaped slaves. No one believes that restoration will resurrect the great rookeries of the early twentieth century, those noisy, stinking colonies of closely packed wading birds first decimated by plume hunters gathering embellishments for women's hats. Florida's scientists know that, if restoration is successful, the Everglades of the twenty-first century will more closely resemble that of the 1970s than the 1930s. But for the first time they are confident it will once again be Everglades. ■



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By

DIRK J. STRUIK

Everybody Counts



Toward a Broader History of Mathematics

The customary way of presenting the history of mathematics has been to start with the so-called Greek miracle of insight, Euclid and Archimedes being the central figures, and then pass lightly over "the Arabs," whose task was supposedly to serve as a transmission belt between the Greeks and the European Renaissance, producing some elementary algebra in the process. Next we continue to Descartes and Newton, and finally arrive at the modern period and the computer. Along the way we usually add some kind words about the Babylonians and the Egyptians with their curious fractions, and the Hindus with their decimal position system (the one we still use).

The fact is, however, that research on mathematics in human society has been undermining this approach for years. For example, early this century, when Brown University historian of mathematics Otto Neugebauer and colleagues deciphered cuneiform mathematical clay tablets, they found that the scientific culture in ancient Sumeria and Babylonia was far more advanced than had been believed. The older mathematicians among us may still remember our surprise when we learned that the theorem of Pythagoras

was known in Babylon at least a millennium before the Greek sage gave his name to it.

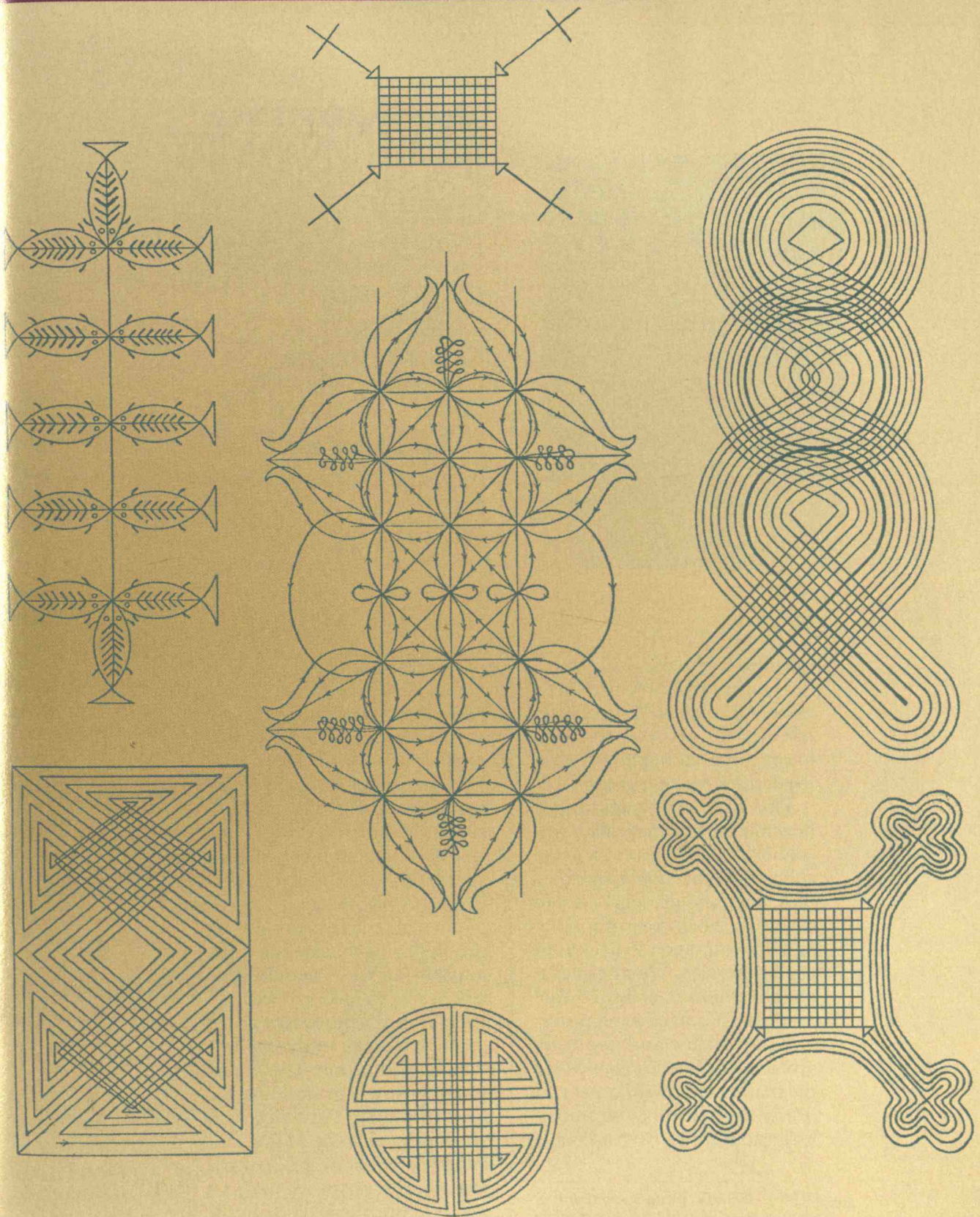
Students of texts in ancient Indian languages have found that series with an infinite number of terms were studied, especially in the state of Kerala in southwest India, centuries before Western mathematicians such as Newton showed a lasting interest in them. And Cambridge University biologist Joseph Needham has shed considerable light on the character and methods of ancient Chinese mathematics, maintained and improved over millennia, in his tomes on Chinese science and civilization. Through its influence on Arabic and perhaps Indian mathematics, this Chinese science has contributed to the cultures of the world.

In addition to this research on ancient societies where reading and writing were well developed, recent studies indicate that people need not be highly literate to show mathematical achievement. Marcia and Robert Ascher of Ithaca College have documented that the Incas of the Andes region, who had little or no script, nonetheless possessed a bureaucracy based on con-

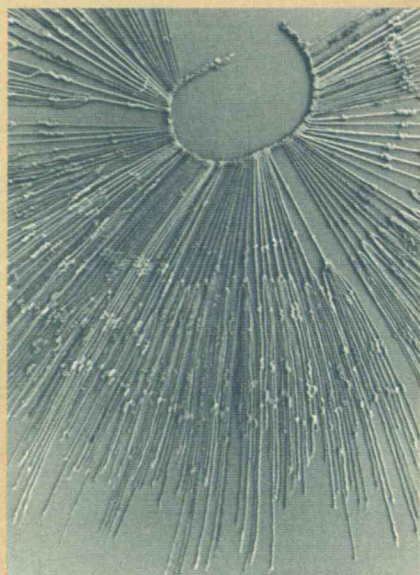
Research

on mathematics in
non-Western societies
is changing our
understanding of this
fundamental human
activity—and helping
educators develop more
effective teaching
strategies as well.

DRAWINGS: SCIENTIFIC AMERICAN (DECEMBER 1948)



Primitive cultures are capable of complex mathematics. These geometrical designs drawn by natives of the Pacific islands of Vanuatu, formerly the New Hebrides, cannot be fully understood without a background in modern mathematical concepts.



siderable arithmetical and statistical ingenuity. They produced elaborate “quipus,” assemblages of colored cotton cords with knots representing numbers in the decimal position system.

This raises the question of how much mathematical knowledge existed, or does exist, in the cultures of other nonliterate peoples, past and present. Seen in this way, the history of mathematics would go far back into the Stone Age. We might discover remnants of Stone Age mathematics in cave paintings and paleolithic and neolithic artifacts. And the search is on for the mathematical concepts and practices that still exist among indigenous tribes. Even accounts

of missionaries and travelers in nonliterate cultures could tell us something about this early mathematics—call it “proto-mathematics,” if you like.

Ethnomathematics—the general name mathematician Ubiratan D’Ambrosio of Brazil coined for this study of the concepts, practices, and artifacts through which we discover mathematical elements among peoples living outside or on the margins of Western culture—teaches us to look at “exotic” forms of mathematics as an intrinsic element of the civilizations in which they have flourished, well worth studying for their own sake. Naturally, such studies have to be seen as an example of the trend toward multiculturalism we hear so much about these days, but it may be more to the point to call

DIRK J. STRUIK, professor emeritus of mathematics at MIT, is the author of Yankee Science in the Making (Dover, 1948).

DRAWINGS AND MAP: *THE CODE OF THE QUIPU* BY MARCIA AND ROBERT ASCHER

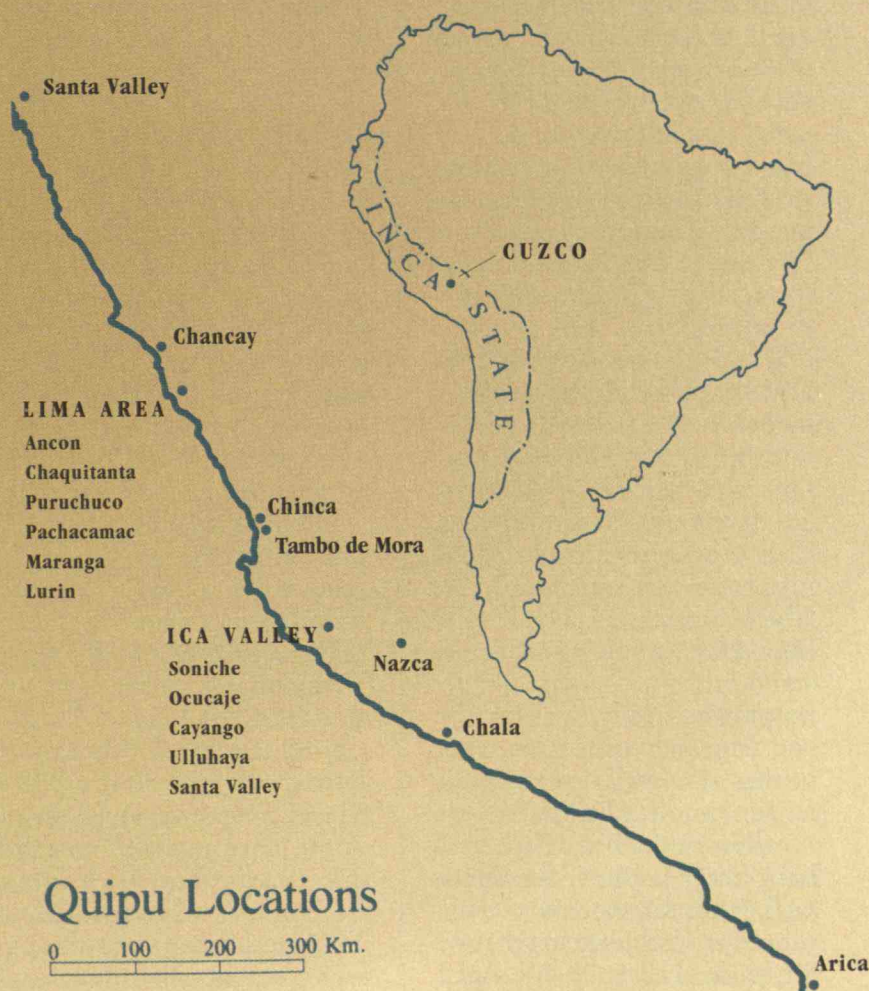
them a protest against Eurocentrism—the bias that leads us to ignore, devalue, or distort intellectual contributions that come from outside Western culture. One important reason for defining ethnomathematics in this way has to do with the fact that the field's scope extends far beyond the ivory tower. Indeed, the goal of many ethnomathematicians is wholly practical: to facilitate the teach-

ing of mathematics in countries where a Eurocentric focus has proven disastrous to education of any kind.

MATH AS CULTURE

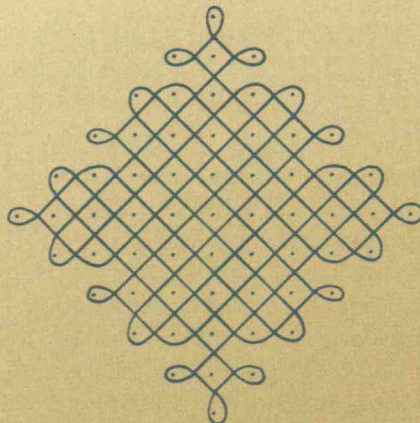
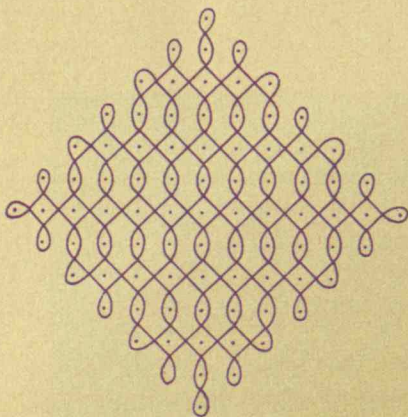
Pioneering work in ethnomathematics has come from Claudia Zaslavsky, who has taught in the New York City high school system. Her book *Africa Counts* surveys

Incas of the Andes region fashioned intricate assemblages of cords called quipus, in which different kinds of knots recorded a wealth of statistical information. The man holding a quipu in the illustration at left was an Incan treasurer and accountant.



Quipu Locations

0 100 200 300 Km.



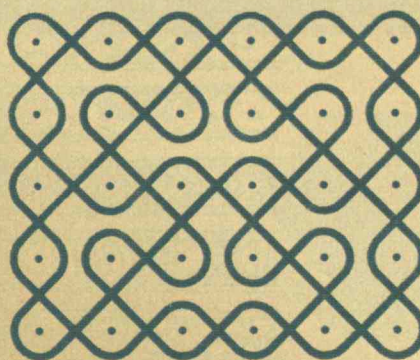
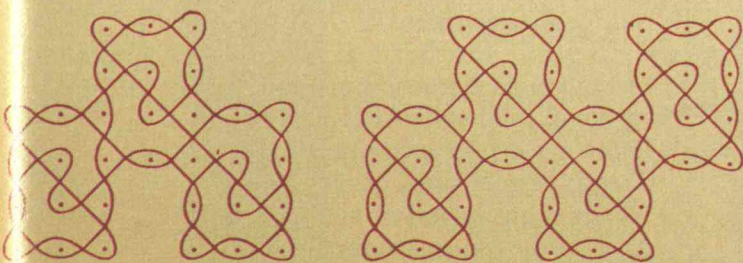
mathematics and its history south of the Sahara, beginning with a bone dug up in Zaire, dated between 9000 and 6500 B.C. Notches carved into the bone in groups could be interpreted as tallying marks in a number system based on ten and referring to lunar phases, hunting records, or perhaps menstrual periods.


Zaslavsky goes on to show how mathematics was used in taboos, riddles, money, architecture, ornamentation, concepts of time, and weights and measures. She mentions magic squares. These are large squares divided up into smaller squares, each of which contains a specific number—the “magic” is that the sum of the numbers in all lines running vertically, horizontally, and diagonally is the same. Some of this may well be extremely ancient and traditional proto-mathematics, but there may have been Arabic influence as well. After all, there was a university at Timbuktu in what we Westerners call the Middle Ages.

Since the publication of Zaslavsky’s book new material has come to light every year. For instance, Paulus Gerdes of the Pedagogical Institute of Mozambique has found significant mathematical content in weaving patterns, describing in considerable detail how the construction of baskets and bags from reeds and other plant leaves might, in millennia of practice, have led to an understanding of abstract geometrical concepts—even the theorem of Pythagoras.

He and his students have also drawn attention to “sonas,” or sand drawings, which belong to a tradition of proverbs, fables, myths, beliefs, and games. Detailing the construction of a standardized sona in Zambia, Gerdes says that a tribe’s drawing experts first create a grid of equidistant points on the ground with their fingertips and then draw one or more lines around the points in a specific pattern. This method enables them to reproduce the whole drawing by

DRAWINGS: LUSONA: GEOMETRICAL RECREATIONS OF AFRICA BY PAULUS GERDES (EDUARDO MONDIANE UNIVERSITY, 1991)



frican sonas, or sand drawings, are executed by making a grid of points and then tracing a line through them in a specific pattern, often without ever lifting the drawing finger or stick. The challenge of accomplishing such feats has fascinated Westerners as well, notably the eighteenth-century Swiss mathematician and physicist Leonhard Euler.

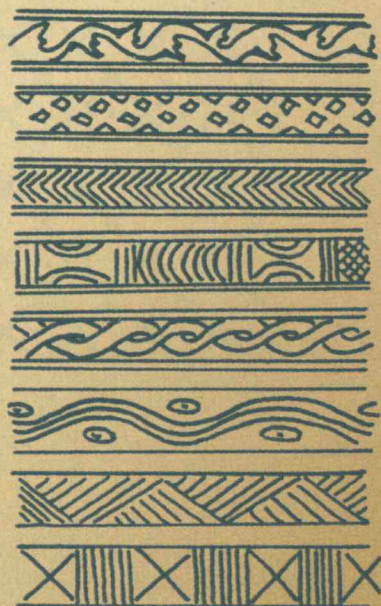
remembering little more than two numbers (the dimensions of the grid) and a geometric algorithm (the rule that determines how to create the pattern). At least one sona, the pentagram, has been absorbed into Western civilization. Part of its magical and mythical character lies in the fact that it is “monolinear”—executed without ever lifting the drawing finger or stick from the surface.

Other outstanding research in ethnomathematics has come from Marcia Ascher, who, in addition to continuing her studies on the Incas, has focused on a wide range of different cultures. For example, she has pointed out that among some indigenous peoples kinship relations follow

patterns that can be understood in remarkable diagrams. She has devoted special attention to the Warlpiri of Australia’s Northern Territory, whose kinship structure has an interesting and complex mathematical structure.

INSIGHT THROUGH ACTIVITY

Research in ethnomathematics has attained new importance as part of the campaign to preserve and revive the traditional cultures of those who have spent centuries under colonial rule. This campaign has been particularly intensive in the newly independent states of Africa, where educators hope to combine indigenous mathematics with instruction in modern ways of counting and measuring. Not only would the approach preserve students’ native culture but it might improve their understanding of mathematical concepts. After all, ethnomathematics is largely the mathematics of everyday life—something students already



know. It stands to reason that the more teachers can capitalize on such knowledge, the less fear mathematics will inspire, and the more effective teaching will be. Recognizing this, the African Mathematical Union and the Commission on the History of Mathematics in Africa publish a newsletter that helps educators stay abreast of studies in ethnomathematics.

Interestingly, the drive to improve mathematical education for indigenous peoples is merging with the drive to improve mathematical education for everyone. Teachers are taking problems from the history of Egyptian, Babylonian, and Chinese mathematics, stressing the multicultural character of the science. But in addition to drawing on the results of ethnomathematical research, teachers are also employing the general principle of building on

the mathematical knowledge and skills students have acquired outside the classroom.

To put it another way, the methods used in teaching mathematics to children in African villages are being extended to American minorities, as well as whites in urban and rural ghettos—and even to students in middle-class suburbs. For example, the newsletter of the International Study Group on Ethnomathematics discusses a teaching strategy based on taking measurements for carpets to be laid in a home. Other lesson plans relate to food buying, employment and wage experience, and gambling.

With all the emphasis on creating a bridge between abstract and practical mathematics, let us hope that the beauty of the field is not obscured but enhanced. For as Gerdes has suggested in his writing on the nature and origin of mathematics, beauty and practicality need not be thought of as opposites.

Unlike those who imagine early humans acquiring mathematics through passive contemplation of objects in nature, he raises the possibility that people might have arrived at such insight through activity.

The concept of numbers could have developed through hunting or otherwise tallying; geometrical concepts could have evolved from the making of artifacts.



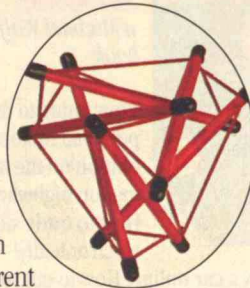
Geometrical analysis

has isolated seven basic types of repeated patterns that can be used to form strips, and the Benin people of Nigeria have incorporated all of them in their elaborate bronze work. These eight strip patterns representing five of the types appear on a single Benin lamp.

ARE YOU PLAYING GAMES?

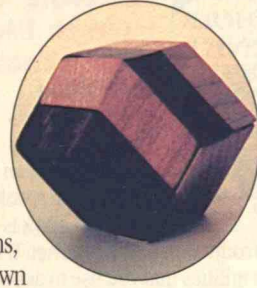
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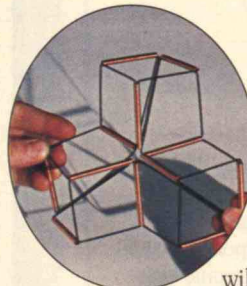


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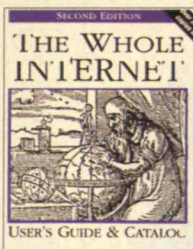
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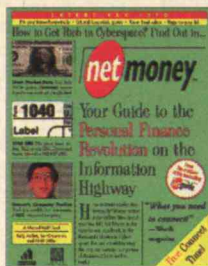
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Continued from page 42

Over generations of experience, these ideas would have been refined. Paraphrasing the Russian anthropologist Boris Frolov, Gerdes notes that even during the paleolithic era, "labor exercised a clearly observable influence on the development of the thinking process." For instance, the ax became smaller and more elegant, taking on a geometrically regular form that could not have been produced unless people developed higher intellectual functioning.

Since the most rational form of an artifact was often one exhibiting attributes such as symmetry, these objects may well have been seen as beautiful. In other words, it is possible that, at least to some extent, both mathematical concepts and aesthetic feelings found their origin in the experience of generations of craftspeople. ■

FOR FURTHER READING

- "Ethnomathematics and Its Place in the History and Pedagogy of Mathematics" by Ubiratan D'Ambrosio, in *For the Learning of Mathematics: An International Journal of Mathematics Education* (February 1985).
- *The Code of the Quipu* by Marcia and Robert Ascher (University of Michigan, 1981).
- *Ethnomathematics* by Marcia Ascher (Brooks/Cole, 1991).
- *Ethnogéométrie* by Paulus Gerdes (Franzbecker, 1990).
- *Africa Counts* by Claudia Zaslavsky (Prindle, Weber & Schmidt, 1973).

MITnews

FROM THE ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT AUG/SEPT 1995

Commencement 1995

Perfect!

JUNE 9, 1995 was, by 10 am, brilliantly sunny and not too hot. The rhododendrons, conveniently put on hold by a late, chilly spring, were in full bloom surrounding Killian Court. The faculty, as usual on such occasions, were colorfully medieval. Marchers from the Class of '45 were resplendent in red jackets, the Class of '70 in gray. Ellen Harris, associate provost for the arts, gave her stunning rendition of the national anthem. Babies were everywhere.

The Commencement speaker, Hanna Gray, was to the point—at once thoughtful and humorous. Similarly, President Charles Vest managed to be both presidential and familial, holding the late Jerome Wiesner up as a model for the Class of '95. Parents glowed; the 1,794 graduates were jubilant. We would have liked a little more festive sunshine for the receptions, but, considering the drizzle on Harvard's graduation the day before, we shouldn't complain.

Hanna Gray is a historian with special interests in the history of humanism, political and historical thought, and politics in the Renaissance and the Reformation. As president of the University of Chicago from 1978 to 1993, she played a crucial role in defining the importance of research universities to

the health of the nation. Gray, who was born in Germany, was one of 12 distinguished foreign-born Americans to receive a Medal of Liberty Award from President Reagan at ceremonies marking the rekindling of the Statue of Liberty's lamp in 1986. In 1991, she received the Presidential Medal of Freedom, the nation's highest civilian award, from President Bush.

In an address that reflected her own long years of talking—and listening—



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August/September 1995

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It's Always Something . . .

Commencement is traditionally a joyful occasion, a day that has been anticipated by students and their families for at least four years—in some cases far longer. This year was no different. But for many at the Institute, there was a pall over the proceedings, cast by a vote in a subcommittee of the House Science Committee to retire the particle accelerators at five universities, including MIT's Bates Linear Accelerator. By June 22, however, the full committee had restored the accelerator funding, an action President Vest credited to fast and focused efforts by Rep. Peter Torkildsen (R-Mass.). As this and other proposed budget-trimming measures that could have tremendous impact on research universities move through the Congress, **MITnews** will report on them in future issues.

—SUSAN LEWIS

Commencement 1995 continued

to alumni/ae and new graduates, she spoke about the role of change in the life of a university. (*The full text of her address begins on page MIT 4.*) She noted, for example, the fact that the "broadened diversity" on American campuses today "is a positive improvement and an educational good," although it does mean that "our campuses as a result have come to reflect more fully some of the problematic tensions in our society.

"Education," she said, "is not meant to be comfortable."

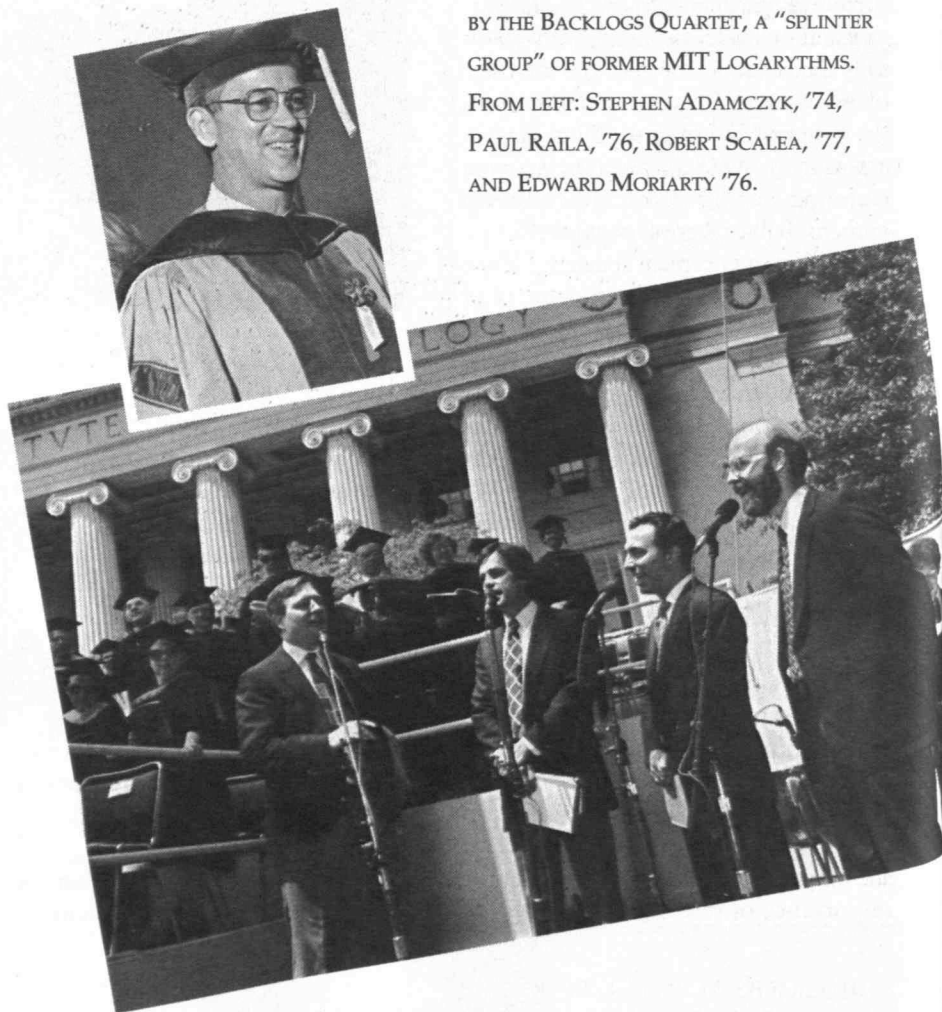
President Vest, in his charge to the graduates, wished for them a "life well-lived," as exemplified by former MIT President Wiesner, who died last fall. Wiesner's was a life that "drew deeply on science and engineering," Vest recalled, "but also encompassed humanism, educational leadership, artistic sensibilities, and statecraft. . . . He main-

tained an international perspective. . . reveled in discourse with everyone. . . worked tirelessly to awaken the world from the nightmare of nuclear stand-off."

Like Wiesner, Vest said, the graduates should "strive to integrate the understandings of humanists and artists with those of scientists, engineers, managers, architects, planners, and social scientists," and, quoting poet Archibald MacLeish on the subject of his friend Jerry Wiesner, they also should "be competent friends and bold companions of the young."

Also addressing the assembly were Roger Kermode, SM '94, president of the Graduate Student Council, who

.....
AMONG THE OCCASIONS FOR MUCH SMILING AT THE COMMENCEMENT CEREMONY, FOR PRESIDENT CHARLES VEST (LEFT) AS WELL AS EVERYONE ELSE, WAS A RENDITION OF "IN PRAISE OF MIT," LED BY THE BACKLOGS QUARTET, A "SPLINTER GROUP" OF FORMER MIT LOGARYTHMS. FROM LEFT: STEPHEN ADAMCZYK, '74, PAUL RAILA, '76, ROBERT SCALEA, '77, AND EDWARD MORIARTY '76.



brought greetings from his constituents, and Mehran Islam, president of his class and presenter of the class gift. Twenty-seven percent of the Class of '95 has already pledged to the gift—the Class of 1995 UROP Fund—which is intended to help the Institute meet the shortfall in federal support for this vital Institute program. The fund is expected to reach \$54,000 (including matching funds from the Class of 1945) by the time these new alums convene for their fifth reunion. Vest remarked that “there could be no more meaningful gift.”

Because some students receive more than one degree, the total number of degrees—2,026—awarded this year exceeds the number of students receiving them. All together, 232 doctorates along with 961 bachelor of science, 818 master of science, and 15 engineer degrees were awarded. In the afternoon, 23 graduating cadets and midshipmen in MIT's Army, Air Force, and Navy Reserve Officers Training Corps units received their commissions at the frigate USS *Constitution* at the Charlestown Navy Yard Historical Park.

The platform party of faculty, administrators, and members of the Corporation assembled to pay tribute to this year's graduates were the first to sit under the new “sail,” a fabric canopy that has protected the group and the stacks of degrees from the elements ever since Commencement moved to Killian Court in 1979. The new canopy was designed by Jerome Milgram, '61, professor of ocean engineering (and a member of the winning 1992 America's Cup team assembled by William Koch, '62.) Milgram also supervised the installation of the new 5,300-square-foot sail, a tensile structure entirely supported by overhead cables in order to avoid obstructing the view of the audience.

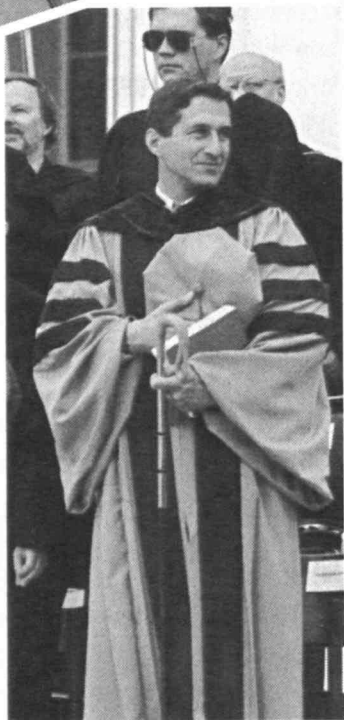
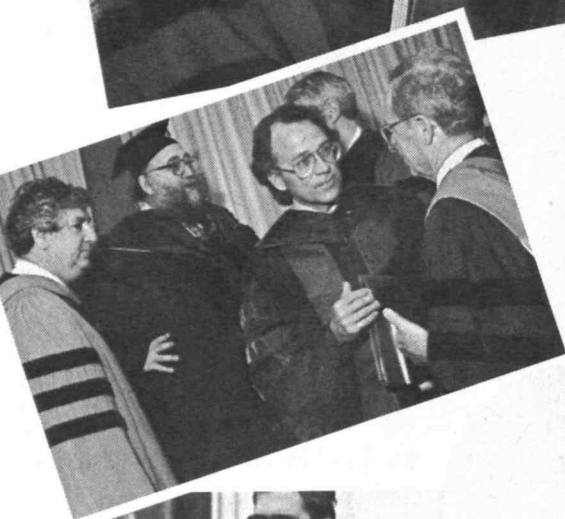
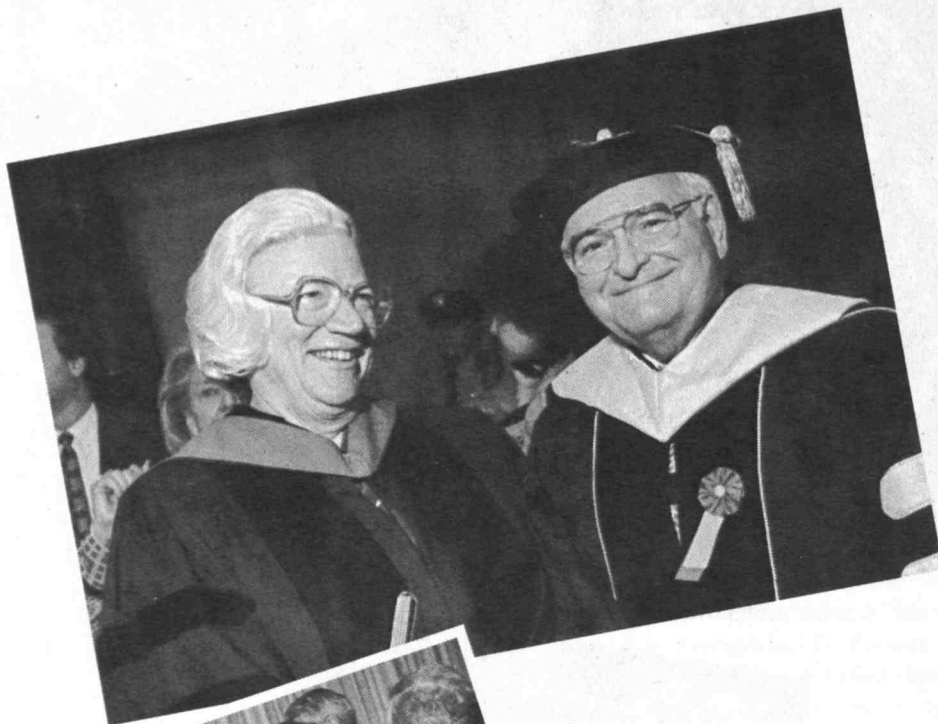
A few additional figures from the day: 8,430 gold and 2,200 black chairs must be set up and dusted (or dried) at the last possible moment; 9,400 disposable raincoats must be ordered and delivered to 4 locations ready for inclement weather; the aforementioned 2,026 individual degrees must be stacked in exact order—

a task for which Physical Plant workers wear gloves; and a group of 60 aides, headed by six marshalls and Arthur Smith, dean of undergraduate education and student affairs, must be trained so that they will be ready to keep the 1,794 graduates in lines that correspond to the piles of degrees. ■ — SUSAN LEWIS



COMMENCEMENT MAY
LOOK THE SAME
EVERY YEAR, BUT

1995 WAS UNIQUE FOR THE KEY
PLAYERS, SUCH AS (FROM TOP
DOWN): THE FAMILIES AND FRIENDS
OF THIS YEAR'S GRADS;
CHIEF MARSHAL (THEN-PRESIDENT
OF THE ALUMNI/AE ASSOCIATION)
GARY SCHWEIKHARDT; PRESIDENT
OF THE GRADUATE STUDENT
COUNCIL ROGER KERMODE, SM '94;
AND PRESIDENT OF THE CLASS OF '95
MEHRAN ISLAM.



Does Alma Mater Inevitably Slide Downhill?

BY HANNA HOLBORN GRAY
President Emeritus, University of Chicago

There is a famous story—famous at least in the Connecticut River Valley—about a crusty, patriotic old Vermonter who lived on an island in the Connecticut River. The border between New Hampshire and Vermont runs along there, and one year a team was sent out to survey it. They discovered quite unexpectedly that the old man

*I*N ALL THEIR COMMENCEMENT FINERY (FROM TOP DOWN, LEFT TO RIGHT): COMMENCEMENT

SPEAKER HANNA GRAY AND CHAIR OF THE CORPORATION PAUL GRAY (NO RELATION).

A COVEY OF DEANS—DEAN OF HUMANITIES AND SOCIAL SCIENCE PHILIP KHOURY, THEN-DEAN OF ENGINEERING (NOW PROVOST) JOEL MOSES, AND DEAN OF MANAGEMENT GLEN URBAN—WITH CORPORATION MEMBER MICHAEL KOERNER.

CHAIR OF THE FACULTY ROBERT JAFFE, SPORTING THE "PROTOTYPE" OF MIT'S NEW, OFFICIAL, CARDINAL AND GRAY DOCTORAL ROBES.

actually lived on the New Hampshire side of the line, and they set out, with considerable trepidation, to give him this news. To their astonishment he replied, "Well, thank the good Lord. I was beginning to think I'd never be able to tolerate another of those goddamned Vermont winters."

Graduates of 1995: yours is the exact analogue to the old man's situation. The boundary that separates you from another Boston winter has been drawn. You have been surveyed and found to be SBs, SMs, and PhDs and all the rest, and therefore citizens of some state popularly called the "real" world. Yet tomorrow I suspect that your spiritual terrain will be roughly the same, and so will you—quite dramatically unchanged if perhaps gratified to have survived into your new citizenship.

You will move on and, at the same time, you will always retain your citizenship in this university. I hope that you will always think of it not as an escape from the world out there but as a real world, too. Without it, the larger world and its possibilities would be impoverished, the quality of its life, its civilizing values and social purposes impaired.

The mission of this university has to do with learning along a broad spectrum of undergraduate, graduate, and professional study. It has to do with learning as

scholarship and discovery of knowledge. It is concerned with learning as the enjoyment of knowledge, creativity, and their products. It is directed to learning as the initiation into a lifetime of taking seriously the process of trying to come to some understanding and wisdom, of committing to the obligation of thought, of critical judgment, of the willingness to confront complexity, to examine assumptions, to see things in their relationships and contexts, and to engage with and benefit from the thinking of others.

These qualities are pertinent to every activity of life, every vocation, every decision, every exercise of citizenship and responsible choice. The university exists for learning in all these senses, and it does so for the long term, not for the pursuit of immediate fad and fashion. Its existence, and its sustenance, represent society's continually renewed investment in the future. Just as your education will have no effective value unless you continue to make its imperatives your own, so the university will not thrive and play its special role in serving society unless you care for and enable its moral and intellectual purposes.

Robert Frost once said, "Education doesn't change life much. It just lifts trouble to a higher plane of regard." That, I suppose, is one of the gifts, and one of the challenges, bestowed on us as thinking beings. It would often be a lot easier not to think, as it would also be easier not to try to see things whole or take into account new or different or difficult or unsettling ways of reviewing what we may have taken comfortably for granted. "It is," said T.S. Eliot, "a part of the function of education to help us to escape not from our own time, for we are bound by that, but from the intellectual and emotional limitations of our own time."

In attaining the status of alumni, you will of course be eligible to receive copious communications of great courtesy and eloquence from your university, rather different in tone from those stern reminders that greeted you in your mail boxes here. You will also find, unless you are very, very careful, that the uni-

versity will, perhaps as early as tomorrow, begin to suffer a permanent state of decline. It is the common experience of graduates that their institution is never quite what it was in their own day and in their memories, and that not to be the same, or the place of one's memory, is inevitably to be less in stature.

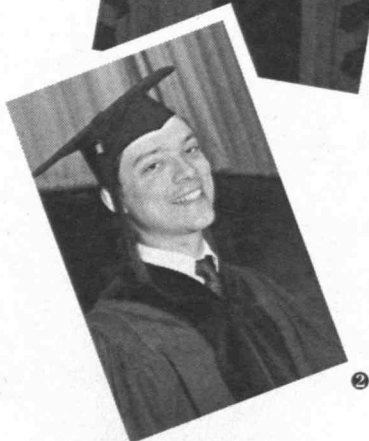
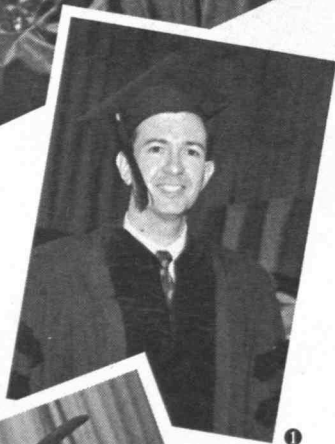
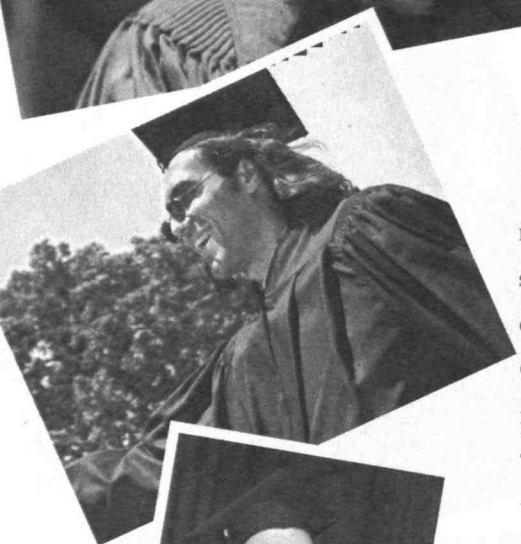
All commentary on education, a subject on which everyone has strong and stubborn opinions, assumes that things are generally getting worse. In fact, if you have been listening at all to current commentaries, you would have to believe that you cannot possibly have

LEIS, BALLOONS, CHAMPAGNE
BOTTLES, EVEN A BEACH
BALL—EACH CLASS

EMBELLISHES THE CAP AND GOWN SOLEMNITY OF THE OCCASION WITH ITS OWN TOUCHES OF COLOR AND FRIVOLITY. AMONG THE MEMBERS OF THE MIT CORPORATION WHO ASSEMBLED TO HONOR THE CLASS OF '95 WAS (CENTER, RIGHT): DR. MITCHELL SPELLMAN, SHOWN WITH HIS SON, DR. FRANK SPELLMAN, AND GRANDDAUGHTER, PIPER.

Commencement 1995 continued





DECORATED MORTAR BOARDS
ARE NOT UNCOMMON, BUT
THIS YOUNG ENGINEER

PROCLAIMED HER HARD-WON PROFESSIONAL
STATUS WITH A HARD HAT. AMONG THE SEA
OF GRADUATES, TWO WE RECOGNIZE:

① WADE ROUSH, HOLDER OF A NEW PhD

FROM THE PROGRAM IN SCIENCE,
TECHNOLOGY AND SOCIETY AND A FREQUENT
WRITER FOR *TECHNOLOGY REVIEW*.

② JOSEPH HARRINGTON IV, '88, PhD '95.

JUST FOR THE RECORD, JH IV IS THE LATEST IN
A DYNASTY THAT INCLUDES JH, CLASS OF
1896; JH, JR., '30 AND ScD '32; AND JH III,
'61 AND ScD '66 (AND ASSISTANT DEAN OF
ENGINEERING FOR DEVELOPMENT).

.....
been educated at all, or educated nearly
as well as people used to be educated,
and you may come in turn to believe that
your successors' fate is even more hor-
rendous.

Why is this? Why do people forget the
wise old saying that "the schools ain't
what they used to be and never was"?
(You will, being at least semi-educated,
recognize this as a rhetorical question.

As Sam Goldwyn put it, "When I want
your opinion, I'll give it to you.") I think
the answer has a lot to do with the ways
in which education and its institutions as
they are thought about get transformed
into emblems of other causes and hopes
and fears. It is instructive to see how
much of the rhetoric having to do with
the decline of higher education derives
from the language of a larger nostalgia
and from romantic visions of a golden
past that never quite existed, how much
has to do with a resistance to major
changes that cannot be argued away.

Universities, seen as institutions
immune to change and even caricatured
for their conservatism, are at the same
time regarded, especially by some of
their own alumni, as institutions that
should not change, that ought instead
to preserve their own past as they, its
loyalists, wish to remember it, a time-
less security against the disintegrations
and disappointments, the corruptions
and uncertain turnings, of a threatening
and fragmenting world. To the degree
that universities mirror the tensions and
shifts within the larger society, they
become objects of the disillusionments
and fears which those evoke—they
appear as once-safe places suddenly
made unfamiliar and dangerous.

I am not for a moment argu-
ing that there is not much to
improve and strengthen
within higher education. But I am argu-
ing that the symbolic and selective uses
of memory and devotion have to be
understood for what they are before we
can think clearly about the state of
higher education and its institutions.

Let me give you just one example.
Once upon a time, people say, there was
greater harmony on our campuses.
Whether true or not, it is certainly true
that once upon a time, and not so long
ago, there was greater homogeneity on
our campuses. And surely to have a
broadened diversity now is a positive
improvement and an educational good.
Our campuses as a result have come to
reflect more fully some of the problem-
atic tensions in our society. An academic
community in which those can be identi-
fied and discussed and understood from
different points of view is in fact a better,

if not a more comfortable, place for learning than the colleges of old. But education is not meant to be comfortable, however enriching.

To think about education is to think about a good deal more. The debates over the nature and uses of education go far beyond the questions of curriculum and academic preparation. Ideals of education, what it should be about, what it should be for, how its worth should be assessed, are statements about the future and the ideals one would wish to see realized in that future, statements about human and social purpose and possibility, about the nature of human society, its needs and aspirations, about the character and direction of civilized existence. They are reflections, too, on the present and its deficiencies and opportunities, and reflections on the past, the lessons it provides to be perpetuated or disregarded.

To think critically about education, then, is to think purposefully about the future and its requirements and to be willing to accept and to help shape the complexities of change. It is to create standards by which to measure the quality of what institutions represent over time in the light of the fundamental values by which we hope to be guided. It is to be reminded that those institutions, and their enduring goals, require continuing renewal, and that this depends on the educated commitment of all their citizens. It is to develop one's vision of hope and substantive purpose for the generations to come.

Another important diversity in higher education rests in the pluralism of our system of higher education itself. We have many different kinds of universities and colleges, many different kinds of opportunities and points of entry, many ways in which to afford choice, on the basis of their special interests and talents and goals, of the particular institution in which students and faculty decide to become members. We should resist the impulse toward homogeneity toward which we are often urged or driven by the rhetoric and regulation of higher education, and so much else, in our world.

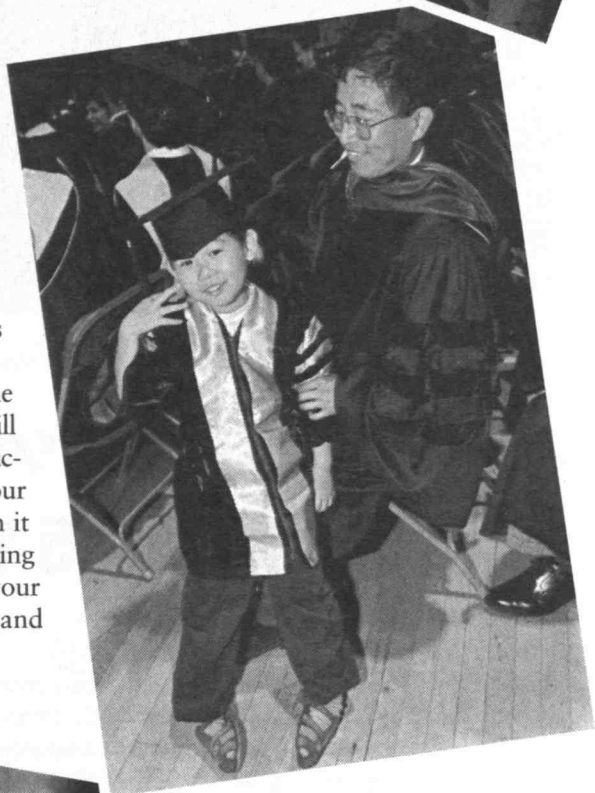
MIT is an institution of great distinction, one in whose uncompromising

dedication to the quality of its own mission you can always take great pride, in part because it has had the courage and continuing foresight to be clear about its own best purposes and to adhere steadfastly to a defined institutional personality that lends shape and weight to its programs of research and education. So you will of course see changes over time, but if they are the changes required to sustain rather than to swerve from its essential ethos, that will be a sign of health and strength, not of decline. Of course, if you begin to see the place offering gut courses or Division I football or an easy life, we will all have to think again.

And now, as you depart for the great world, I will leave you with one admonition, drawn from the philosopher Pete Seeger: "Do you know the difference between education and experience?" he asked. "Education is when you read the fine print. Experience is what happens when you don't."

I hope for all of you that the fine print on your diplomas will speak to a satisfying and productive experience throughout your lives, one that will carry with it good memories and continuing care for what matters about your university. Congratulations, and good luck. ■

Commencement 1995 *continued*





The Hand—and Heart—Behind Commencement
Mary Morrissey
to Retire After 45 Years

Most of the people whose lives have been affected by Mary Morrissey and her work have no idea who she is.

Her official title is director of special events and director of the Information Center. Most important to tens of thousands of alumni/ae, for 20 years she has been executive officer for Commencement. She's the closest thing at the Institute to royalty—with all its tradition and ceremony. (She even has the "crown and scepter" in her office, gifts that acknowledge her role in overseeing the inauguration of President Charles Vest in 1991.)

Of course, no one starts his or her working life as the manager of events with a cast of thousands. One of Morrissey's tasks as a junior employee in the

MIT Information Office in 1950 was sitting alone in a stately but barren Lobby 7, notarizing draft-board documents for students eligible for service in the Korean War. She looks at the vibrancy of lobby activity today—with its drop posters, hacks, art installations, and the like—as a sign that MIT can change. "That's how you have to grow. There's no blind adherence to tradition here."

That being said, she has always nurtured tradition. Once she took over the reins of Commencement, Morrissey—working with the all-Institute Commencement Committee, the Physical Plant Department, and other members of the operations team for graduation—has tried to instill a sense of pageantry into what is the most important public occasion at the Institute. In the process, she and her collaborators created the

Commencement Master Plan, one of MIT's thickest planning documents.

The first change on her watch, and the most momentous, was the move to Killian Court. "Prior to World War II, [Commencement] was in Symphony Hall, and then in Rockwell Cage, a very limited and unsatisfactory venue," says Paul Gray, '54, ScD '60, now chair of the Corporation. The Cage was particularly uncomfortable for an event that occurred at noon on a summer's day. But the real problem was Rockwell's fixed size vs. the steadily increasing number of graduates every year.

With the enthusiastic endorsement of the students on the Commencement Committee, a plan was put together in 1979 to hold the ceremony in what was then known as the Great Court. "Hank Leonard, Gerry Wilson, and I worked together weekly to put that plan together," recalls Morrissey. (Henry Leonard was superintendent for support services in Physical Plant, and Professor Gerald Wilson, '61, ScD '65, a former dean of engineering, was then the chair of the Commencement Committee.)

The new site was just the beginning. Morrissey was troubled by the fact that passing out diplomas took so long that the graduates and audience all drifted away, and almost none were left in their seats by the time the last graduates walked up. While attending a nephew's graduation at West Point, she observed the solution: "parallel processing"—two processions of graduates receiving their diplomas simultaneously. "With some volunteers, we timed such a procedure at MIT and found we could cut the ceremony by one hour this way," she reports. The proposal met with fierce resistance at first, but she argued successfully that each family was only focusing on one person. "I had to appeal to the students to stay

until the end out of respect for each other, and I'm happy to say that they do," she says.

Her other changes have included moving the departmental receptions outdoors and creating a space in Lobby 7 for families to gather for coffee and cookies. A most important innovation is the "hooding ceremony" for doctoral candidates: each new PhD and ScD holder is draped with a hood of medieval design, symbolizing membership in the community of scholars, but the ritual added time to Commencement. So Morrissey suggested inviting those graduates and their families to a ceremony the evening before, presided over by the dean of the Graduate School, Frank Perkins '55, SCD '66. Now in its fifth year, the hooding ceremony is both a familial occasion *and* a great time saver.

Commencement 1995 *continued*

tributing degrees by school, and many had no idea where they should be. Each crisis spawned more meetings, more refinements of the Commencement Master Plan, a determination to do better.

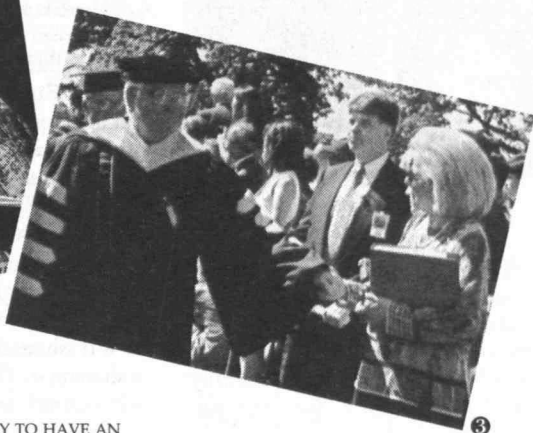
The end result is best expressed by Kathryn Willmore, executive assistant to the president and secretary of the Corporation: "Mary raised our standards for MIT's Commencement and special events to something that corresponds with the nature and stature of who we are today. She brought a sense of our traditions, of celebration, and of her very special grace and style. Now there is a more dignified, ceremonial aspect to Commencement."

Morrissey has been centrally involved in every memorial service, dedication, and celebration held at the Institute in the last two decades. "Mary was the key person for planning and follow-through for the memorial service for Jerry Weisner," says Paul Gray "including the list of speakers. I was quite prepared to turn it over to her and knew that it would be done right." His confidence in her has paid off—many say that memorial was one of the loveliest and most meaningful events ever held at MIT. That confidence is built of a very long relationship: Gray was one of those freshmen in Lobby 7 in 1950, draft documents in hand, and Morrissey later organized his inauguration as president in 1980.

In everything she organizes, "Mary is always asking 'How will this nurture the community?'" says Willmore. "She's able to bring people from all levels of the Institute together on the same plane: faculty, carpenters, Corporation members, students, administrators, technicians, custodians, everyone! She's always dignified and treats others with dignity, which has to do with the sense of community she engenders with her activities."

Mary Morrissey will retire in September, leaving an indelible stamp on the university she served. ■

ROBERT DIMMICK is the executive assistant to the executive vice-president of the Alumni/ae Association.



IT WOULD BE EASY TO HAVE AN
ENTIRE MITNEWS THAT
CONSISTED OF NOTHING BUT

PICTURES OF PEOPLE WHO LOVE WORKING WITH AND DEEPLY ADMIRE MARY MORRISSEY. WE OFFER A SELECTION: ① FROM LEFT, DAVID FERRIERO, ASSOCIATE DIRECTOR OF THE LIBRARY; KATHRYN WILLMORE, SECRETARY OF THE CORPORATION; GAIL FITZGERALD, WHO WILL TAKE OVER FROM MORRISSEY AS THE NEXT EXECUTIVE OFFICER OF COMMENCEMENT; MORRISSEY; AND PROFESSOR MARTIN SCHLECHT, CHAIR OF THE 1995 COMMENCEMENT COMMITTEE. ② MORRISSEY, HOLDING THE COMMENCEMENT MASTER PLAN, GREETES PRISCILLA GRAY, WIFE OF CORPORATION CHAIR PAUL GRAY AND AN HONORARY ALUMNA. ③ GRAY, WHO FIRST MET MORRISSEY WHEN HE WAS A FRESHMAN, GREETES HER WITH THE WARMTH BORN OF LONG FRIENDSHIP AS HE ENTERS KILLIAN COURT.

"Commencement is something so personal and private, you have to think of one student and one family to keep perspective," says Morrissey, describing her guiding principle.

Morrissey has faced her share of crises: Commencement speakers with their own podiums, Secret Service agents with their own phones, and weather with its own agenda. No one who was there will ever forget the Commencement of 1986, when radar failed to show a coming storm, and students stood shivering in a downpour to receive their degrees. Then in 1993, when torrential rains forced Commencement inside, "it was terrible, a disaster," laments Morrissey. Families did not understand the system of color-coded tickets paired with indoor venues for dis-

Staying Connected with the MIT Mindset

This is my first column as president of the MIT Alumni/ae Association. As incoming president, I have been thinking about MIT and the role of the Association. I'd like to share some of those thoughts.

It was 25 years ago that I marched up to receive my degree from President Howard Johnson. At that time, I did not have many expectations about the alumni/ae organization. I was focused on the future and excited about the new people I would meet after MIT and the new experiences I would have.

Since then, I have had a variety of experiences—graduate school up the river, an internship at a newspaper in Miami, journalism and finance classes in Chicago, jobs as a reporter and editor for *Business Week* and the *New York Times*. I married a classmate—Greg Arenson, '70—and had a daughter. Through it all, I have been fortunate that most of the experiences have been challenging and that the people I have met have been interesting.

But as the years have passed, I have increasingly come to value my MIT friends and my MIT experiences. When I turned 40, I could not imagine a better way to celebrate than to invite a group of old friends from the Institute to join me for a long weekend. And as I pass other milestones or encounter problems or questions, it is often my MIT friends that I turn to—former classmates, faculty, and staff. I share my thoughts and feelings with them, bounce ideas off them, ask them questions, or seek their advice.

One of the special delights of my career as a journalist has been to continue to meet people connected with MIT. That has also been a dividend of staying involved with the Institute, both through the MIT Alumni/ae Center in New York City and in Cambridge, through visiting committees, the Alumni/ae Association, and the Corporation.

What is so special about MIT types? They are certainly smart. But there is something else. It is a way of looking at the world, a way of thinking and talking, of being analytical. It is a mode of gathering information and using it—of relating to the world. It is the thing that made me feel so quickly at home the first time I visited the campus during my senior year of high school.



Although I was one of the relative few who did not head to MIT to major in science or engineering (I studied economics), I nevertheless had an MIT style of processing information. I don't think it necessarily makes one a nerd or a geek. Rather, it can make one an astute observer of the world and an interesting person to talk to. It has always given me particular delight to meet and talk to other people who speak the same language and relate to the world in similar ways.

One question we all face is how to maximize the interactions after we graduate. This is where the MIT Alumni/ae Association comes in: it can act as a facilitator. It does this through the traditional support of clubs, receptions, and speakers from the Institute in cities around the country and around the world. It also supports on-campus activities, such as reunions, conferences, and other gatherings. It reaches out to alumni/ae and brings them back to campus for programs or visits, or to serve on its boards, on committees, or on the Corporation. It publishes *Technology Review* and a newsletter of Association activities.

The Association is also trying to develop new ways that alumni/ae can interact with each other and with the Institute. It has

been bolstering communications with alumni who hold only graduate degrees, particularly through events based in the schools, departments, and laboratories. It launched a World Wide Web site in June, and continues to explore other means of Internet communications.

I have begun talking to some of the Association staff about other possible types of interaction as well. For example, I would love to be able to tap into more of the richness that is MIT—to be able to see or hear more of the speakers and conferences, even if I am not in Cambridge. Perhaps audiotapes or videotapes could be made available, or we could tap in directly via computer modem.

There is a lot of richness to share: everything from the annual Killian lectures to events like the appearance of author Salman Rushdie on campus; from forums on the world economy or competitiveness to competitions like the 2.70 Contest. Last year's Alumni/ae Leadership Conference (ALC) featured prize-winning faculty from the fast-growing Department of Biology, talking about their most recent work and MIT's newest freshman requirement. This year's Technology Day topic was how WWII shaped MIT and how peace is reshaping it. This year's ALC in September will examine technology and leadership.

As I write this, it is June, and I am heading up to Cambridge to partake directly: first to hold up one end of the class of '70 banner in the Commencement procession, then to participate in my 25th reunion.

In the months to come, I look forward to hearing about how you connect with MIT—if at all—and about your ideas for other ways the Association can be useful to you. And I look forward to meeting many of you as I visit some of the MIT clubs.

In the meantime, I encourage you to write to me at 125 W. 76th St., Apt 2A, NY, NY 10023, or reach me on e-mail at <dhbm13d@prodigy.com> at home, and <arenson@nytimes.com> office.

Karen Arenson

KAREN WATTEL ARENSEN, '70
President, Association of Alumni
and Alumnae of MIT.

ClassNotes

16

Please send news for this column to:
Bob O'Brien, acting secretary
25 Keith Rd.
Pocasset, MA 02559

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We regret to report that **Enos W. Curtin** passed away December 7, 1994. Although he had lived briefly in Salt Lake City, he will be remembered as a longtime resident of New York

City, where he was active in the field of investments and real estate.

The *Review* will appreciate any additional background that can be supplied, especially by members of the MIT Club of New York and alumni/ae of other classes who enjoyed participating with him in alumni/ae activities.—**D.P. Severance**, '38, acting secretary, 7 River Woods Dr., F219, Exeter, NH 03833

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200, 77 Mass. Ave.
Cambridge, MA 02139

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Please send news for this column to:
Bill Langille, secretary
20 Rogers Rd.
Far Hill, NJ 07931

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Please send news for this column to: Class Notes Editor
Technology Review
MIT W59-200, 77 Mass. Ave.
Cambridge, MA 02139

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75th Reunion

Our notes were interrupted last month—as we prepared to mail them—by the sorrowful news of the loss of a grand lady, **Helen MacKenzie St. Laurent**, wife of the late **Raymond A. St. Laurent**, chemical engineering, cooperative, and popular president of the Class of 1921 who served that post so capably for many years.

We were unable to include more than the facts of Helen's passing and unfortunately, no additional references can adequately pay full tribute to her love, loyalty, and generous support of our beloved MIT.

For the record, Helen was born in Boston on September 27, 1898, and died in early morning on March 8, 1995, in her palatial home in Manchester, Mass.

The St. Laurents had no children and her closest survivors are two nieces, **Joan MacKenzie Davies** of Toronto, Ontario, and **Helen MacKenzie** of Bridgewater, Nova Scotia, as well as several grandnieces and grand-nephews, all in Canada.

Helen and Ray enjoyed many years in their comfortable Manchester home and summering in their vacation homes in Vinalhaven and in Center Lovell, Maine. Helen actively participated in several charitable and civic endeavors as a member of the Center Congregational Church, Manchester, as well as the auxiliary of Manchester Memorial Hospital.

She will particularly be remembered for heading the hospitality committee for 1921's five-year and interim reunions besides valued assistance and other courtesies to the class.

We have noted that funeral services were attended by **Glenn P. Strehle**, '58, VP and treasurer of MIT, and by **D. Hugh Darden**, assistant treasurer.

Timewise, we first met Helen on those occasions when Ray escorted her to undergraduate affairs in our student days, and it always was a treat for Maxine and your scribe to spend time with the couple on Vinalhaven or in Manchester. We last spoke with Helen by phone only a few weeks before her death. We'll miss her greatly.

We beg you to send us interesting pictures of your student life and stories of memorable events of those days so we can maintain this column.—**Carole A. (Cac) Clarke**, president and secretary, 608 Union Ln., Brielle, NJ 08730-1423, (908) 528-8881; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274, (310) 833-1480

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A nice story about **James Carter** was printed in the *Bangor Daily News* in March, a few weeks after his 97th birthday. Since 1967, he has lived in the town of Hampden,

Maine, where he moved from his home on Cape Cod to marry **Rose Shaw**. She died in 1980, but Carter stayed on, having roots and branches secured in this small town.

Carter's first wife had died shortly after he had retired after 42 years of work as a consulting engineer. His studies in electrical engineering at MIT with the class of '22 were interrupted by service in World War I.

The "exhilarating pace" of a week in his life is described in the newspaper article: "Monday is laundry day, and an evening meeting with the local historical society. Tuesday was quiet this week. Wednesday, he visited his dentist and then attended a potluck supper at his church. And then there is his work with the Hampden Food Cupboard. 'We started that in 1993,' Carter said, 'distributing food to needy people once a week on Wednesdays.' Thursday is Kiwanis day. In the afternoon,

Carter is at the Kiwanis Civic Center 'with a couple of the Key Club kids,' to set up tables for the dinner meeting. Carter served as treasurer for eight years, and is still active on several committees. Friday, he goes shopping with his stepdaughter. Saturday evening, he'll be at the door collecting money for a Kiwanis bean supper. Sunday is church day. In the afternoon, he writes letters to his family."

A daughter from Massachusetts and a son from Ohio visited him for his birthday. But Carter still likes to travel himself, going to his reunion at Phillips Andover Academy in June, Thanksgiving at his son's, and Christmas at his daughter's. And he still drives his own car about, though his family has asked him to limit his driving to about 60 miles at a time.—*ed.*

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

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We learn something new every day. I didn't know the Class of 1923 had a garden located outside the Alumni/ae pool, complete with shrubbery and dogwood trees. The planning

office wishes to alert the class in advance about renovations which are to take place from the fall of 1995 to the spring of 1998. They assure us that the garden will be replanted after construction has been completed.

I have just received word of the passing of **William L. Barclay** on January 24, 1994. He had an SB degree in engineering administration, and was active in a number of different companies. He is survived by a son and a daughter.

William E. Appleton passed away on July 12, 1994. He had both an SB and SM in electrical engineering, Course VI-A, and his last address was in Tampa, Fla. He is survived by a son.—**Royal Sterling**, secretary, 2350 Indian Creek Blvd. W., Apt. D201, Vero Beach, FL 32966-5103

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Please send news for this column to Co-secretaries: **Katty Hartford**, 237 Hacienda Carmel, Carmel, CA 93923; **Colonel I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

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Writing as of early May, the name of **Stanley Lane** may be added to the list of those planning to attend the reunion. **Gates Burrows** reports that, with his son, he may make it.

However, Professor **Y.H. Ku** writes that he regrets that he can't make it because he finds traveling difficult.

The name of **William Edward May** has

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appeared on the list of classmates for many years; but with no known address. **Sam Spiker** reports that his 1990 fraternity address book lists Bill as deceased as of August 6, 1975.

A triviality but perhaps of interest to some classmates is the fact that the Class of 1925 graduated on June 16, 1925. Seventy years later, to the day, comes the 70th Reunion on June 16, 1995.—**F. Leroy "Doc" Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26 70th Reunion

Please send news for this column to: **Donald S. Cunningham**, secretary, c/o Ronald F. Frazier, 132 Middle St., Braintree, MA 02184

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We have lost two illustrious classmates. **George B. Darling** of Hamden, Conn., died on March 30, 1995, after a long illness. After attending MIT, he received a PhD in public health from the University of Michigan in 1931. He held executive positions with W.K. Kellogg Foundation of Battle Creek, Mich., from 1932 to 1943 and was responsible for the foundation's grants and fellowships. From 1942 to 1945, he was vice chairman of the medical science division of the National Research Council in Washington, D.C., where he became an expert in the administration of medical and scientific affairs.

George came to the Yale faculty in 1946. He was appointed director of medical affairs and was responsible for coordinating the Yale School of Medicine, the Yale School of Nursing, and the Department of University Health at the Grace-New Haven Community Hospital, now the Yale-New Haven Hospital.

From 1957 to 1972, he served as director of the Atomic Bomb Casualty Commission in Hiroshima. During that time he conducted research on long-term radiation effects of the 1945 atomic bombings of Hiroshima and Nagasaki.

It was a joint undertaking of the National Academy of Sciences and the Japanese government. Leading a team of American and Japanese scientists, he carried out extensive research on how the atomic bursts continued to affect the health and life spans of the residents. This involved periodic examinations of survivors who suffered varying degrees of radiation burns. The results threw new light on the behavior of genes and cancer cells.

In 1967 he was awarded the Golden Orchid Award, the supreme award of the Japanese Medical Association. He also received a U.S. Atomic Energy Commission citation for Meritorious Service. He retired in 1974 as professor emeritus of human ecology at the Yale School of Medicine.

John W. Norris of Marshalltown, Ind., died in his sleep on December 19, 1994. His father, D.W. Norris founded the Lennox Co. in Syracuse, N.Y., and when he died John became president. In 1927, just when the heating and air conditioning industry was on the brink of fundamental change, he started his 44-year career at the Lennox Co.

His son John W. Norris, Jr., '60, remembers

his father had sharp business skills and a special genius for product development. His son writes: "He also had another kind of genius—working with people. He firmly believed in educating employees and never much cared for formal bureaucracy. Of course, those were simpler times, but it was said he could walk through the Marshalltown plant and call most of the employees by name."

Over the next four decades, he was responsible for many basic innovations in the HVAC industry. He was the first to develop a forced air heating system using blowers to push the air through longer pipes and heat larger homes and buildings. He was the first to produce enameled furnace cabinets and he developed the first furnace designed for atomic installation. A manual he wrote in 1948 became a "bible" for Lennox dealers and many others in the industry.

In 1952, he developed Lennox's first residential central air conditioning system. He later oversaw such landmark projects as the Duracurve heat exchanger and the first packaged direct multizone rooftop heating/cooling units.

John Jr., now president of the company, sums up his father's life: "After retiring as president in 1970 and until his death, my father continued to take an active and highly vocal interest in Lennox and the HVAC industry. It was only fitting, since he had played a large part in making the industry what it is today." We send our condolences to his family.—**Joseph C. Burley**, secretary, Isle of Springs, ME 04549; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

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There is no news of members of our class as of this writing, but there has been further attrition of our numbers. Advice of two deaths has been received, as follows: **Peter**

John Zugale passed away on January 20, 1995, in Jamesburg, N.J. Pete spent his working years at New Jersey Bell Telephone Co. **Roland Deming Earle** died April 16, 1995, in Plantation, Fla. Roland was a lifelong "Dixie Cup" chemist, to use his own designation, doing much of his chemistry-related inventing in his kitchen as well as his corporate activities in his own companies and for U.S. Rubber. Noteworthy was his involvement in the development of synthetic rubbers for WWII barrage balloons and the decoy ships and armor used on the D-Day invasion of France.

We regret the loss of our classmates and wish for comfort to their families and friends.—**Ernest H. Knight**, president and secretary, 168 Ai Plummer Rd., Raymond, ME 04071-6349

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Rolf Zurwelle writes, "Dear brothers of Class of '29, Recently my letters to **Laurence Luey** were returned by the post office. Laurence suffered a heart attack last year. I

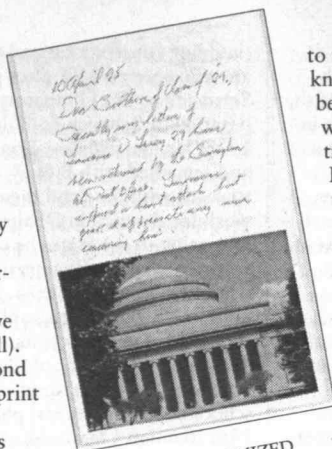
would appreciate any news concerning him.

"Several years ago Zurwelle Co. became a non-profit but still very active in many phases of engineering management. By the grace of almighty God, my mental health is good, but

the body at 89-plus has the usual age problems. However, it is my pleasure to help people and companies. And most important, my theory on gravitation and space energy is being revised, which is natural (we can never stand still). Hopefully, the second revision will be in print soon. One original copy of the thesis is filed in the MIT archives library.

"In reviewing this theory, please keep in mind what is now called mass is in reality electric energy. This concept does not change the characteristics of the atom as believed heretofore by many."

Please send news for this column to: Class Notes Editor *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139



THE CUSTOMIZED STATIONERY OF ROLF ZURWELLE, '29

to work for Philadelphia Electric, now known as Peco, where in due course he became superintendent of construction, in which capacity he supervised the construction of four of Peco's major power plants. During WWII, he taught radio and electronics to officer candidates at Drexel and Temple Universities. From 1952 to 1964, he served on the Haverford Township, Pa., school board as a member and president. During his tenure on the board, he oversaw the building of three elementary schools and the current township high school. After his retirement in 1973, he and his wife, Fay, were active for 20 years in the Greater Main Line branch of the Red Cross. Besides participating in numerous blood drives, he was branch chairman for three years and

was in charge of the branch's buildings and motor service. In 1991, he and Fay received the Red Cross Chairman of Volunteers award. Besides Fay, Granger is survived by four sons, two step-daughters, 15 grandchildren, and seven great-grandchildren.—Gordon K. Lister, secretary, Apt. 40-D, 5707 Williamsburg Landing Dr., Williamsburg, VA 23185

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By the time these Notes appear, our 65th Reunion will be history. As of this writing (April), 20 classmates have responded that they plan to attend. The October issue

should have my reunion report.

Henry Nelly, who received an SM in Course X-A in 1930 and from whom we have not heard in quite a few years, sends a report. He retired many years ago and now lives in Paradise, Calif. He writes, "Live alone. Pretty low key. Excellent health. Reading is hobby." I would say that at our age this is an upbeat report. . . . Frank Nettleton notes that he will become 91 shortly before our reunion. He lives in Essex, Conn., where his retirement activities include bridge, swimming, billiards, and bowling (in two leagues). Al Sims stops by to see him on trips back and forth between Prudence Island, R.I., and Englewood, Fla. Al started with our class and was Frank's freshman roommate but did not graduate until 1931.

We have received notices concerning the deaths of two more of our classmates: Adolph Hugin on December 20, 1994, and Granger Schrader on February 27, 1995. After receiving an SM from MIT, "Dolph" Hugin went on to obtain an LLB at Georgetown University, an LLM at Harvard, and an SJD from Catholic University of America. Thereafter, he practiced patent law in Washington, D.C., for a number of years. He was active on various committees of the American Patent Law Association and American Bar Association, as well as in a large number of Catholic lay organizations. From 1949 to 1954, he was editor-in-chief of the *American Patent Law Bulletin*. In addition to obtaining patents for others, he held ten patents on inventions of his own in various fields. After his retirement to North Springfield, Va., he became an active horticulturist, experimenting with flowers, grasses, and shrubs.

After obtaining an SB and SM in electrical engineering from MIT, Granger Schrader went

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65th Reunion

John Swanton writes to Wyman Boynton from Wiscasset, Maine: "We had a good chat last

evening, and I was glad to hear you are all right. I was tired of seeing the notices in the *Review* that you hadn't received any news. I hope the rest of the class sees the notices too and does something.

"Louise and I proudly report that we have just spent our first full winter in Maine. The local folks tell us that it wasn't much of a test, for it was milder than most winters, less snow, and we really shouldn't get much credit. We haven't really officially left Massachusetts yet, waiting for our George St., Newton house to sell, but at least we've had a year of practice.

"Last summer our children treated us to a celebration of our 60th anniversary, with a tent here on this lawn. All 5 were here, 18 grandchildren, 6 great-grandchildren, many friends from the near and distant past from Arthur D. Little and Polaroid, and many long-time Maine, Newton, and MIT friends. We were both pleased we could be on hand ourselves to take in the delightful event. I seem to have recovered from the depression difficulties I had during the 60th Reunion. Louise has taken on a spell of Parkinson's. She seems to be handling it well, and is almost as hard to keep up with as ever.

"We have seen one classmate pair. Lillian and Al Sims visited before making their way back to Florida from Prudence, Ind., last fall. They had taken the Saguane River Boat trip and told us about it. We were able to report to them the final publication of our 200-page booklet, *Westport once Jeremysquam*. Louise was the editor, I was merely the helper. To our collective joy, it has met with good response and sold well. It was done for the Westport Community Association."—ed. (Wyman P. Boynton, secretary, 668 Middle St., Portsmouth, NH 03801; (603) 436-1309)

ClassNotes

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Robert Klein has responded to my urgent request to classmates for news. He and his wife, Mary Elizabeth (married for 56 years), continue to live a full and creative life. He writes:

"Congratulations to the staff of *Technology Review* for its well-deserved recognition of excellence and readability—all very true!

"Over the last year or so, my wife, Mary Elizabeth, and I have had a 10-day annual theater trip with friends from the Cleveland Play House Theater to London where we saw about a dozen plays and visited several homes, including eight or ten rooms of Queen Elizabeth's Buckingham Palace and Princess Di's Spencer House. We are off again in May for a similar trip to London including the Chelsea Flower Show and Sissinghurst and on to Edinburgh (where we were privileged to fund a visit a year or so ago to the Edinburgh Festival by a dance-drama group of MIT students).

"In February we were at the Sandy Lane Hotel in Barbados for several days and then boarded the *Silver Cloud* with a group of Cleveland travel friends to visit Venezuela's Angel Falls and Guyana with its bauxite and iron ore mines, and then island hopped for two weeks back to Ft. Lauderdale and Palm Beach.

"Each year we go to 8-10 plays at The Cleveland Play House, about 24 concerts of the Cleveland Orchestra, church most Sundays, and about a dozen performances of opera, ballet, and jazz groups here and there.

"In between trips, I headed up a successful Endowment Fund development program for the Cleveland Institute of Music and am currently heading up one for University Circle here. The good Lord willing, we are off to New York for a Metropolitan Opera Council week in April, and then a few days in San Francisco with a group sponsored by the Cleveland Museum of Art, which I guess is to say that life can hardly ever be dull for MIT grads in a big city. Best wishes to all."

We have another heart-warming story of a classmate of ours. Arthur Marshall and his wife, Rebecca, have a life-time record of community service to Springfield, Mass., in recognition of which Congregation Kodimoh is helping them celebrate their 62nd wedding anniversary. Western New England College is also having a reception for them for their recent sponsorship of the "Human Relations Lecture Series." Also, the Association for Transportation Law is holding a ceremony in Vancouver to pay a special tribute to Arthur for his outstanding support of the Association. . . . Rose and Tom Weston send a nice letter from Manley St. Denis. All those that make the trip to Hawaii are assured of a well-planned "get together."

Mrs. Francis Kirkpatrick writes that husband Bill Kirkpatrick died on March 20, 1995, of Alzheimer's. For years Bill interviewed young people interested in going to MIT. He was always pleased when one of them was accepted. . . . We learn that Frederick Henderson, died July 6, 1995. Before retiring, Frederick was director of the first comput-

er center of the Rochester Institute of Technology in Rochester, N.Y. He was a member of the Honorary Engineering Society, Tau Beta Pi, and the American Society of Engineering Education. Henderson was also a member of Surfside United Methodist Church. During World War II, he served as a lieutenant senior grade in the Navy. He is survived by his wife Audrey, two daughters, and three grandchildren. . . . News has reached us that **Charles Behse**, died February 27, 1995. He formed a company that manufactured agricultural chemicals for farmers in Texas, used by citrus growers. Behse was a former division manager for Remington Arms Co. at the Denver Ordnance Plant. He worked in landscaping for 20 years. He enjoyed gardening, photography, and travel. He was past president of the William H. Jackson Camera Club. Survivors include his wife, a daughter, and son.

Alex Daunis and his wife have moved into a retirement home. He misses his former house and notices his declining energy level. He tells us that his friend, Thomas Kevin Fitz Patrick, '33, recently died. He was the designer of our present MIT Ring—the Brass Beaver.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Edward Simpson gets top billing this issue. He was delighted that **Leonard Julian** and wife Doris visited Ida and him when they were in Florida. Although Ed attended sev-

eral MIT gatherings while in Florida, he was looking forward to returning home to Squantum and to the 62nd Reunion. The Simpsons also planned to attend grandson Jonathan's high school graduation in Austin and grandson Hugh's graduation from the U.S. Naval Academy in Annapolis. Ed enclosed a recent article on the sale of **Gordon Bunshaft's** former residence in East Hampton, N.Y., by the Museum of Modern Art for \$3.2 million to the famous Martha Stewart who is better known for her Connecticut farm with its exotic chickens and folksy bread-baking decor. A spokesman for Ms. Stewart put it this way, "She's becoming very interested in the modern thing." Since the Bunshafts had no children they had decided to leave their entire estate, including the house and their major collection of 20th-century art, to the Museum, of which Gordon was a trustee. Gordon Bunshaft was our very celebrated architect classmate who passed on in 1990; his wife, Nina, surviving him until May 1994. I must add that my wife, Mildred, who is an avid gardener and crafts person, breathes and lives by every word of Martha Stewart whether on TV or in her magazine. The Bunshafts lived in their temple of classic modernism with pondside neighbors Steven Spielberg, Calvin Klein, and Ronald Perelman; no wonder Ms. Stewart wanted in.

Acknowledging the commitment of a lifetime to Armenia, **V. Lawrence Parsegian** was presented with an honorary doctorate by the president and VP of the Yerevan State University which has for 75 years been at the forefront producing scientists, scholars, diplomats, and outstanding leaders for Armenia. The stage was set for the presentation at a February 25, 1995, reception in Washington, D.C., attended by 60 distinguished officials.

Parsegian graduated from MIT in physics

and later received a doctoral degree from NYU. Since 1954, Lawrence has been with Rensselaer Polytechnic Institute, as dean of the School of Engineering, professor, and then in 1975 he continued on as professor emeritus. Knowing Lawrence at the MIT Armenian Club, I have heard him speak eloquently on many Armenian-related subjects, but none so indelibly as when he spoke of the hundreds of aging and devastated Armenian churches which he transposed to microfiche photographs in several volumes. These churches, which date back to the early 7th century, may never be restored but Parsegian renders them inspirationally.

Knowing that **Edward Atkinson** lives in Amherst, the same town as the UMass basketball squad, and loving that sport at my local high school and also at the collegiate level, I mentioned to Ed that UMass Coach Calipari might be induced to coach basketball at MIT. Ed says his neighbors on the faculty of UMass have grown "unrestful at the tail wagging the dog." But for now, Ed seems to think Coach Calipari's job is safe at UMass.

Of the many deaths to report, the most baffling is **George V. Sweetnam** (Course XV). A letter addressed to him at his Bradenton, Fla., residence was returned, marked "Deceased." The date of death has been established as November 8, 1994, but survivors are unknown. What we do know of George comes from his own hand as recorded in our 60th Reunion Classbook. Working many jobs in the 1930s, in 1936 he joined United Carr Fastener (behind the dorms on Ames St.) as they embarked on component manufacturing for the electronics industry. He remained with them for 38 years, mostly with the Ucinite Division in Newtonville. He opened the N.E. Sales Offices for all divisions of United Carr in 1959. Retiring in 1974, he relocated to Florida in 1975 and had lived at the same Bradenton address.

Although **Francis O. Merchant** was in Course IV, he did not culminate his architectural education with the 22 classmates who received a BAR. However, his performance in the architectural jungle was remarkable and quite varied prior to settling down as a self-employed architect in Long Beach, Calif., at the end of World War II. Beginning as the treasurer and tax collector for South Thomaston, Maine, from 1933 to 1935, he apparently paid his dues and became an A.I.A. registered architect. We learn that he received a U.S. War Dept. certificate for architectural-engineering service with the Manhattan district (electromagnetic) in Boston from 1941 to 46. Francis Merchant has been written up in many *Who's Who* as follows: *Pacific Coast*, 1949, 1951; *West*, 1956; *Commerce & Industry*, 1953, 1955, 1957. Widowed after a short early marriage to Mary Bussell in 1936, Francis then married Elsie A. Forsman in 1939 with whom he had a daughter and two sons. Mrs. Francis O. Merchant (the same Elsie) reports her husband's passing as New Year's Eve, 1994. Listed among his hobbies are sailing, golf, and camping. He was a director of the Long Beach golf club, a member of Kiwanis as well as the Alamitos Bay Yacht Club, and, of course, the American Institute of Architects and the MIT Club locally.

The *Wellesley Townsman* reports the passing of **Edward S. Rowell** as of February 15, 1995. Edward Rowell was a Course XVII

(building construction and engineering) graduate who entered MIT after preparing at Swarthmore (Pa.) Preparatory School. His career began with Babcock & Wilcox Co., N.Y.C., in 1938. He married Bess Louise Clark in 1939 and remained with B & W until 1952 when he took off with Bess and their two young sons to work for Aramco in Dhahran, Saudi Arabia. Returning to the States he continued on with Stone & Webster Engineering in Boston from whence he retired in 1975. He had a slew of hobbies such as photography, model trains, recreational chemistry, many organizational activities as president of the local PTA (concentrating on music and the organization of a school band). As several photographs in the 25th Reunion Classbook attest to, Ed Rowell was especially attached to his wife, Bess, and their two sons, Edward S. Jr., and Clark, who are mentioned as his survivors along with three grandchildren. A memorial service was held in the Unitarian Universalist church in Sherborn, Mass., where he had lived for the past 12 years.

I regret reporting the loss this last February 18, 1995, of a fellow graduate in Course IV, **Margaret Burnham (Kelly) Geddes**, one of the three great young women to receive their BAR with our class. In any informal discussion with us novices as to protocol or direction, Kelly's word was final. Coming to MIT with that famous Chicago planner's name Burnham and with matriculation from the Wheeler School and Vassar College, she was head and shoulders above the rest of us as freshmen and on through the five years for that bachelor's degree. Born and raised in Evanston, Ill., her family moved to Providence, R.I., in 1922 where most of her career developed as she practiced architecture primarily in city planning and housing development. The firm of Geddes and Kelly was established there with husband Peter Geddes. During World War II she served as a planner with the FHA in Washington, D.C. Margaret was a Phi Beta Kappa member, secretary of her AIA chapter, life member of the Providence Art Club, a member of the Agawam Hunt Club and the League of Women Voters. A few months ago we were alerted by her sister Ellen Kelly of Concord, N.H., that Margaret was to be reached at the Hallworth House in Providence. Nothing more was said. She passed on there leaving as survivors the aforementioned Ellen Kelly, a brother and several nieces and nephews. No one can remotely surpass her for the friendship which everyone felt in her presence.

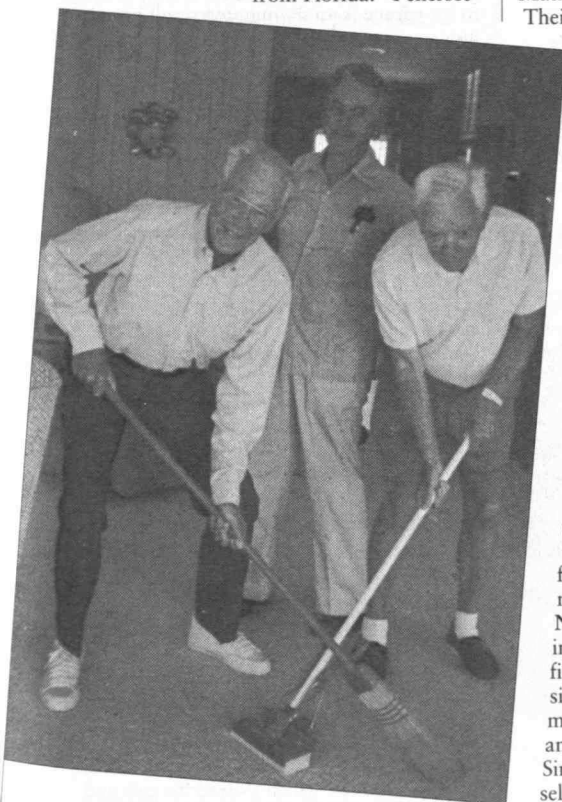
Finally the end of obituaries for this issue of *Technology Review*. **Lewis William Moore**, Course X (chemical engineering) passed on in Escondido, Calif., on March 13, 1995, as reported in the *Chicago Sun-Times*. Beginning in 1933 with Standard Oil of Indiana as a research chemist at their Whiting refinery, he was transferred two years later to Pan American Petroleum and Transport in N.Y. where he was named general manager of manufacturing. Shortly after, he became president of Pan American Refining Corp., an arm of Pan American Petroleum and Transport which he headed as president in 1953. When Pan American merged with American Oil Co. in 1954, L. William Moore became Amoco's executive VP. He became president there when Amoco became Standard Oil's national marketing subsidiary. His retirement from Amoco in

1970 came after serving on its board for nine years. He served in the 1960s with the board of the Community Fund, part of the Crusade of Mercy in Illinois, where he was an Illinois Institute of Technology trustee and director of their Research Institute. The 1933 *Technique* says he came from the California Institute of Technology, entering MIT as a sophomore and taking part quite notably here in the Baton, Musical, and Glee Clubs. The *Chicago Sun-Times* lists as survivors his wife, Arlene, two daughters, three grandchildren, and four great-grandchildren.—**Berj Tashjian**, secretary, 1245 Briarwood Ln., Northbrook, IL 60062-4556; tel: (708) 272-8683

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We have news this month of the death of Frederick Perry, of Reading, Mass., in October, 1994. He is survived by his wife Pauline. Fred retired from service with the U.S.

Government. We have no other details. . . . To more cheerful news. We have a letter and photo from president **John Hrones** who writes us from Florida. "I enclose



A LITTLE BROOM HOCKEY
From left: Ed Sylvester, '34, Dick Lawrence, '35, and John Hrones, '34.

a picture of Ed Sylvester, Dick Lawrence, '35, and myself. As the picture may indicate, Ed and I were the defense pair for the hockey team. Dick was the manager of the 1933-34 team. According to Dick that team won more games than any MIT hockey team has ever won. In those days, MIT played Harvard, Yale, Princeton, Army, DC, BU, Northeastern, Dartmouth, Williams, University of N.H., and Brown. Ed and his wife Esh spend several months each year in Boca Grande, Fla., where we were their guests.

Ed continues to pursue his life-long interest in improving the steel casting process. He has developed a new method of producing ingots for the making of stainless steel sheets. Ed and Esh reside in Shaker Heights, Ohio." Other '34 members of that team were **Frank Miliken** and **Roger Williams**. John is in his last year as a director of the MIT Alumni/ae Association. He has also been president of the MIT Club of Southwest Florida for some years. He does judging at local high school science fairs, and is a director of the condo association where he lives in Florida. About the time of this writing John should be flying North to Jaffrey, N.H., for the summer.

We have learned from **John Newbegin** that **Al Rogowski** died. Details will be forthcoming. You can write to Al's wife, Anita, at 171 Pleasant View Ave., Apt. 133, Smithfield, R.I. . . . Our treasurer **Larry Stein** and wife **Jeri** have just departed for a two-week trip, where they will visit the Statue of Liberty and Ellis Island in New York, spend four days in Washington visiting the Holocaust Museum, the Vietnam Veteran's Memorial, plus as many other sites as they can squeeze in. Then on to Mathews, Va., where they will visit friends. Their itinerary will also include a visit to

Chincopee Island, which is the home of the wild horses. On the way home, they may stop and visit Atlantic City. To be safe from any temptation Larry invested all the class funds in a treasury bill before he left so that we know our treasury is safe!

A report from the Katherine Dexter McCormick '04 Society lists the following members of the Great Class of 1934: **Gerhard Ansel**, **Edward Asch**, **Bernadette** and **Henry Backenstoss**, **Walter Bird**, **Samuel Blake**, **Margaret** and **Robert Ebenbach**, **Mary** and **James Eder**, **Mrs. Louis Frank**, **Mary** and **Russell Hastings**, **John Hrones**, **Bess** and **Harold Thayer**, **Samuel Untermeyer**, and **Mollie** and **Carl Wilson**. Membership is based on those people who have remembered MIT in their will or participated in a Planned Giving Program.

When your secretary started planning for notes for this month, there was no material in the files. In scouting around, **Norm Krim** told me that he had a very interesting resume of **Jerry Minter's** in his files. Jerry was contacted for his permission. When granted, Norm sent it along to me. Jerry was born in Fort Worth, Tex., and graduated from high school at age 16. Since he was 11 years old, he built radios, selling them, repairing them, and by the time he was a senior in high school, he was selling, building and installing public address systems. At 16, he was too young to enter Tech, so he spent a year at N.A.T.C. in Arlington, Tex., entering MIT as a sophomore the following year. While at Tech he continued to service and install radios for many car dealers and also installed audio systems in several clubs. Returning to Texas after graduation, he built a ham radio station from scratch. This station still exists on the family homestead. One of the contacts Jerry made as a ham radio operator led to a job in Boonton, N.J., at the Boonton Radio Corp. where he designed measuring instruments and meters for the princely sum of \$15 per week. While there he met **Harry Houck**, who at that time

ClassNotes

was chief engineer at Micamold Radio Corp. in Brooklyn. His work at Boonton eventually led to his first patent, "Selective Transfer of Electrical Oscillatory Energy," in December 1943. A gentleman by the name of R.W. Seabury started a company in Boonton around 1922 to make molded radio parts. They then started the development of improved vacuum tubes and special test equipment, resulting in the granting of many patents to the company that was known as Radio Frequency Laboratories. In the early '30s, the RFL patents were sold to RCA for several million dollars, and RFT became inactive for several years. This company had attracted many bright people who were later to start other companies in the Boonton area, among them the Boonton Radio Corporation. In 1935, RFL was reactivated. They had varying contracts with government aircraft suppliers, and Jerry joined them in late 1935 for a special assignment. Unfortunately, at that time FDR inspired the IRS ruling to tax all corporate surpluses at 100 percent. Since RFL was starting out with the proceeds from the sale to RCA, this ruling put RFL out of business and Jerry out of a job. He went to work for another company in Boonton that had been started from the original RFL group on various aspects of radio instrument design. When the owner, a Mr. Ferris, died, his wife selected a manager who had all the traits of Simon Legree and Scrooge combined. Result, Jerry and his co-workers left and started their own company, operating out of the house that Jerry was renting. For the next several years they were harassed by their former boss to prevent their appearance at trade shows, use of their company name, and various restraining orders. Jerry finally went to court and succeeded in having the restraining order lifted. At this point (1940), Jerry married **Monica Hanlon** who had a job! They shared a house with another couple, and managed to spend only two dollars per week on groceries. The new company was heavily involved with designing radar equipment using one of their instruments for standard signal generation. At that time, the term "radar" was not used. It was called "ultra high frequency direction finding"! They then developed various pulse generators, which with the start of World War II, led to heavy military orders. The company expanded, and development continued, including many developments in the field of television signal generation. Jerry received four patents covering various developments, some of which were not granted until after he had sold his stock in the company. He then started as president of Components Corp., the company which Jerry eventually bought and still operates to this day. Some of his accomplishments: the elimination of TV interference by auto ignition systems, equipment for making high-fidelity master records for FM stations, and extra long-play records, recording heads, tape stabilizers, the design of the famous *Popular Science* Test Record which ran over a million copies, a compatible stereo disc for 33 $\frac{1}{3}$ records and many other developments in the field. Many of these resulted in patents for Jerry. The above

account ends in 1954 and we have told you in an earlier issue about some of Jerry's more recent accomplishments. When we spoke to the Minters recently, they were anxiously awaiting the birth of their first great-grandchild, whom they hoped would be a little girl.

A letter from **Jim Eder** tells us briefly of a reunion of 15 fraternity brothers in Savannah, Ga. Attending from the Great Class of 1934 were **Dot** and **Gordon Brown**, and **Sam Brown's** widow, **Natalie**. He enclosed a pic-



The extended Sweeney family, with Jim, '34, and Lee in center front (see '34 column for more information).

ture of **Jim Sweeney** and family that he had meant to give me in San Diego. Noteworthy in addition to the handsome family, is that the infant in the photo is the Sweeney's first great grandchild and that since the picture was taken, another has been added. The father is a Navy pilot who flew from the carrier *Ranger* over Iraq in Desert Storm. . . . This concludes our notes for this issue. Your calls, letters, postcards are all equally welcome. Our objective is to be able to mention at least 12 to 15 class members in each issue with some news of their activities, but it cannot be done without your cooperation.—**Carl H. Wilson**, secretary, 48 Druid Hill Rd., Newton, MA 02161-2023; tel: (617) 527-7088

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Irving Banquer telephoned to let me know that **Howard Beck** died April 18. He mailed a copy of the obituary from the *Boston Globe*. Irving died at the Beth Israel Hospital

after suffering a heart attack several days earlier. He was a pioneer in the development of the first continuous automated furnaces, which combined the precise temperature control and exotic atmospheres necessary, for the then nascent semiconductor industry as well as ceramics, powder metals, and nuclear fuel. In 1950 he founded BTU Engineering, a manufacturer of high-temperature furnaces for the semiconductor industry. Howard was awarded 30 patents in the field of furnaces and controls for the electronics, technical ceramics, and metallurgical industries. He was a founding member of the International Society for Hybrid Microelectronics. In 1981 he was presented with the Daniel C. Hughes, Jr., Memo-

rial Award "For Outstanding Technical Contribution to Hybrid Microelectronics." He is survived by his wife, Gertrude, a daughter and son, a brother, and two grandsons.

We celebrate the lives of three more of our classmates. **Copeland C. MacAllister** died December 31, 1994, in Framingham, Mass.; **Vinton K. Ulrich** died January 16, 1995, in Damascus, Md.; and **Utey W. Smith** died on March 11, 1995, in Devon, Pa. Copeland (Course VI) had a long career in electrical

engineering and manufacturing. He was employed by General Electric during World War II. He was a long-time member of St. Bridget's Church and was a lector. He was a member of the Lion's Club and active in other charities. He is survived by his wife, Margaret, two daughters, six grandchildren, a foster daughter, two sons, and a sister.

Vinton (Course VI) is survived by his wife of 52 years, **Evelyn**. Any classmate who can tell us anything

about his career, please phone or write to me.

John C. Tebbetts, Jr., wrote to me with details of the death of **Utey**; after years of struggle with asbestosis. During WWII he was chief of the asbestos section of the War Production Board. He was in Course XV and broke into the asbestos industry with the Johns-Mansville Organization in 1937. He became the manager of the Megnesis Insulation Manufacturers Association and was later appointed sales manager of Ehret Magnesia Manufacturing Co. in 1950. He is survived by his widow, **Madelaine**, a son and daughter, and two grandchildren.

John Tebbetts writes that his wife, the former **Lucille Scudder** (Simmons, '35), died August 29, 1992, one day after her 78th birthday leaving him with two married daughters and three grandchildren. **John** was **Utey's** best man on September 9, 1939, and **Utey** was **John's** best man a week later on the 16th. **John's** recent five-year driver's license expires in 2000, the date of our 65th Reunion!

I will have one week after the Alumni/ae Lunch on June 16th to write the notes about the reunion and beat the June 23rd deadline when I shall be with family in Oklahoma. I hope they have a typewriter. Hope I saw you.—**Allan Q. Mowatt**, secretary, 715 N. Broadway, #257, Escondido, CA 92025-1880; tel: (619) 432-6446

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60th Reunion

An April weekend visit to the Hilton Head area produced a wealth of information and recollections from **Harry Hazelton** (Course

XV), **Marshall Holcombe** (IX-B), **Thomas Nelligan** (IX-B), **Thomas Terry** (X), and **Louis Young** (X). **Harry** and wife **Elizabeth** put me up in their guest room. On the way home via Atlanta airport, **Roman Ortynsky** treated me to lunch at Peachtree City. Two weeks later, a similar excursion to the Birmingham suburb of Detroit netted more eyeball conversations, and it will take two issues to cover both areas, so please hang in here.

Harry, Mal, and **Tom Nelligan** were relatively early settlers (1970s-'80s) at Hilton Head, but the development dates from 1952. Much earlier it had been named by natives for its 1650 discoverer, British Captain **William Hilton** (not **Conrad**—no connection). The project suffered financial straights, a buyout and bankruptcy, and emerged in 1983 when a sizable group of resident owners, including classmates, bought the infrastructure. This consisted of dirt roads, no sewer lines—just an unorganized locality, ("everybody knew everybody") paying taxes to the county without adequate representation. **Harry** especially was "in at the creation," working mightily to fulfill, in a 60-day period, all the state requirements for incorporation. Hidden in a hallway to his garage is an illuminated scroll honoring him as town organizer and a member of its first council. It has grown like toadstool to about 35,000 residents full or part time. **Harry's** 1992 open-heart surgery and 1994 femoral artery repair have not slowed him very much—he still plays golf, but twice a week, down from three.

Mal Holcombe bought H.H. property in 1970 for summer use after retirement. After Harvard Law School and many years in intellectual property practice, he retained a client by joining it (now AMP Corp.) and heading its legal department, with offices in Harrisburg, London, and Tokyo. **Mal** has suffered temporary blindness at times for over 20 years, and now glaucoma. During winter months in Naples, Fla., he practices amateur barbering at the hospital. His father **Amasa M.**, MIT '04, also practiced patent law and knew **Katharine Dexter** (McCormick), '04, as a co-ed. . . . **Tom Nelligan**, adding to his career report in the April issue, told of buying the ailing **Pokorney Manufacturing Co.**, a producer of check valves, in 1960. He rebuilt the business and its staff, devised new models for pressure and vacuum applications, and won contracts—for U.S. Navy vessels, including Trident submarines, for **Sears Roebuck** sump pumps, and numerous other uses. Retiring to N.H. in 1981, he devoted his energies to golf. He has had to pursue less vigorous activities, following a mild stroke which slowed his gait and swing.

Louis Young, on an island near St. Helena, was unable to see me, but his voice rose to the occasion of my call from the gate house. For 10 years he has suffered from emphysema, and last year a brother died with that affliction. On a 50th reunion biography form mailed to him recently, he told of his MIT experience 1939-40, when he taught three subjects, including an economics course that he had flunked once as an undergrad. In 1941 his paper on "Randomness in Ordered Sequences" was published in *Annals of Mathematical Statistics*. Before leaving Lockheed in 1960, he had strongly recommended straight-through loading-unloading capability for the C-141. It was some satisfaction to see it

adopted on the C-5.

Tom Terry in Savannah recalled so many incidents, and people involved, that a tape recorder would have been useful. Soon after graduation and Chemical Engineering Practice School (X-A), he told class secretary Elwood Koontz the pluses and minuses of his new job. Tom's bosses were also MIT and readers of Class Notes, and were somewhat chagrined at the report. Tom was varsity tennis, squash, and soccer, and remembered Scott Rethorst as top-notch on the court, Mike Pettebone excelling as manager (won the Swartz award), Ollie Angevine on the soccer field, Wayne Hazen snowshoeing on Mt. Washington, Phil Hart in chemistry class, Laddie Reday and Boris Maximoff—ad infinitum. In World War II he was left for dead on a North African battlefield with a bullet wound a quarter inch from his heart. Yet he was spotted during a moment of consciousness, and rescued by Jeep to the medics. With recovery, and five battle stars later, he was on a ship heading out the Golden Gate for more, on the day of Hiroshima. For a guy who suffered loss of memory on and off for the first eight years back in civilian life, he is now a walking class directory.

Footnotes to Tom Kato's tribute: Harold Miller has known the family since 1935, when he met Tom's mother and father at their New York home. About 1960 Tom and his daughters visited Harold at his Scarsdale home, before the girls went to California to finish their education. The teenagers ("two lovely living dolls") stood the entire time in the pres-

ence of their father and their host, according to custom. Harold also visited Tom in Tokyo, about 1977 and in 1988. Alice Kimball saw Tom in Tokyo about 1975, and using the fit of her MIT ring, got a "brass rat" he desired. . . . Responses to the canvass of silent classmates are accumulating, and we will try to catch up with reports next issue.

Cheers for the life of George Dudley Mylchreest! The *Hartford Courant* tells of his death March 1. "Dud" won honors beginning in his teens—the Thomas Edison Award in high school, magna cum laude and Phi Beta Kappa from Wesleyan University, the Meritorious Civilian Service Award for developing critical ordnance during World War II, and patents on numerous devices from R&D for Hartford Empire Co., later Emhart Corp. He joined the class as a junior in Course I. In 1989 his wife, Laura, quoted Dud that his MIT days were "happy and rewarding." He was then suffering Alzheimer's disease. She predeceased him.—Frank L. Phillips, secretary, 1105 Calle Catalina, Santa Fe, NM 87501; tel: (505) 988-2745; James F. Patterson, assistant secretary, 170 Broadway, Pleasantville, NY 10570; tel: (914) 769-4171

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Received a newsy letter from Bert Bennison. He writes, "Before retiring in 1981, I had about 10 years at Tallahassee with the State of Florida, mostly solving public health

ClassNotes

problems in the panhandle area. These efforts were amplified by doing some graduate-level teaching at FSU in what was euphemistically called health planning. My easily controlled enthusiasm for the sporting scene was counterbalanced by the nationally recognized FSU student circus which got better each year we were there. I believe you have earlier reports of what are called my mid-life changes. Going backwards, they include: professor and head, Dept. of Biological Sciences at Drexel University, in Philadelphia; assistant director of research, Ortho Research Foundation in Raritan, N.J. [the "pill," plus the IUD]; assistant director of medical research with Esso Research and Engineering Co. in Linden, N.J.; a stop for an MPH and Board Certification at the University of Pittsburgh; director of the rapid-tempo chest X-ray survey team for the USPHS Division of TB Control; commissioned medical officer at NIH, Bethesda, Md., publishing on malaria and, when the war was over, on cancer research. Two daughters, and two sons include, from the top: a lawyer, a computer-nik, an environmentalist, and an actor. One granddaughter thus far. Since retiring I've been on a lot of community board of directors, for example: an ambulatory health clinic, local and regional historical societies, Friends of the National Seashore, and Coalition for Human Services. I am now in the process of divestment from most such challenges, to have more time for friends and seashore and puttering." Bert started off by stating that his health has held up pretty well. He says that friends have said that some of the preventive medicine, that has been his professional "specialty" has rubbed off on him. But Bert says that his wife of 50-plus years has taken great care of him. A fine update, Bert (All of our classmates should take note, then Len and I would not have to worry about material for the Class Notes.)

On a March trip to Florida we visited Martha and Joe Smedile. They are doing fine and Joe is busy with his homeowner association activities. . . . Sidney Levine writes that he is busy "surfing the net" with his Macintosh computer. His e-mail address is: America Online <paspasid@aol.com> and Prodigy <pycwa@prodigy.com>. . . . Evan Edwards writes, "One month after retiring from Kodak, unexpectedly, I became the curator of Hoffman Clock Museum, which continued for ten years." Evan obtained his first patent while a graduate student—and his last patent 50 years later, with 38 patents total. Evan's hobbies are clocks and travel.

We are sorry to learn from Blake Loring's wife that her husband is in the middle stages of Alzheimer's disease.

It is with sadness that I report the death of four of our classmates. Van Buren Hansford, William B. Burnet, Donald Stuart Duncan, and Winthrop A. Johns. Win Johns was our class secretary while we were at Tech. I will report further details when I receive them for Bill Burnet, Dan Duncan, and Win Johns. I do have the details for "Van." Van was the founder and former chairman and CEO of Hansford Manufacturing Company Corp. He



The late Robert Burns Woodward, '36, considered by many to be "the Einstein of synthetic chemistry," was featured last spring on an episode of the PBS series *The Nobel Legacy*. A child prodigy, Woodward was only 19 when he graduated from MIT. A year later he earned a PhD from MIT, and in the following year he joined the faculty at Harvard. Something of an eccentric (he had 200 identical blue ties made from the same bolt of cloth) and the subject of countless stories, Woodward

was the first to synthesize quinine (vital to the U.S. troops in the WW II Pacific theater), cortisone, cholesterol, chlorophyll, tetracycline, strychnine, and reserpine (the first of the tranquilizers.) He was awarded the Nobel Prize in 1965 and taught at Harvard until his death at age 62 in 1979. "Before Bob, people thought they couldn't make a molecule. . . it was too complicated," says fellow Nobel laureate Roald Hoffman. But Woodward "opened up the imaginations" of scientists.—excerpted from the *Harvard Gazette*.

was a philanthropist who was active in many community organizations. He was the founder of the Rochester Hospital Foundation, a member and past president of the Rochester General Hospital Board, a former president of the Planned Parenthood of Rochester and Genesee Valley. He is survived by his wife, Jane, two sons, two daughters, and seven grandchildren. All of the bereaved have our deepest sympathies.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890; **Leonard A. Seder**, assistant secretary, 1010 Waltham St. B345, Lexington, MA 02173

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John A. Kostick of Sherborn, Mass., retired about 11 years ago from a life of science, earning a living by practicing chemistry and physics. He devotes his retirement years to

turning back to his first love which is the arts. Making up for lost time, he has produced at least four dozen essays drawing on notes which he accumulated through the years. *About Time!* (copyright 1994 Sherborn Writers) begins with the birth of Isaac Newton, briefly refers to the ancient Greek deliberations, relates the development of Newton's laws and concentrates on his conception of time, concluding that Newton did for time what the Greeks did for space—idealizing it into an exactly measurable dimension. John then goes on to Einstein's theory of relativity with the premise that time is not absolute but relative. He continues with modern physics relating to quantum mechanics and chaos the-

ory, and believes that the preferred scientific picture is that of a universe evolving towards a future that in many respects is left open.

This 1,300-word essay is written in language suitable for general high school consumption. John wrote *Don Severance* that it was written primarily for his granddaughter. John also sent a second essay of 4,000 words entitled "About Time and Space," which develops the concept of time in more detail portraying the thought of Einstein and Rutherford, exploring how classical physics concepts broke down, and giving examples of mind experiments.

How about some of the rest of you classmates letting us know the kind of results you are achieving with your avocations during these retirement years?

Here in the Washington, D.C., area, I missed one of our staunch supporters at the MIT Club of Washington winter meetings; and when I got around to calling Ruth and Frank Kemp to find out if one of them had been having health problems, I was pleased to learn that all was well. We hadn't seen them because in late January they had left for a six-week trip which included a stay in Florida, then a two-week voyage through the Panama Canal to San Diego, followed by a journey to Phoenix, Ariz., and a ride back to San Diego via Los Angeles before returning home to Alexandria, Va.

In the Nov/Dec Class Notes, we included excerpts from Richard Domonkos's letter extending his gratitude and relating the importance of an award from the Class of 1938 Scholarship Fund. He was one of nine students

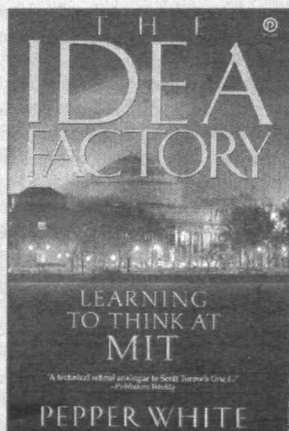
who benefited from this fund in the 1994-95 period. The other eight include: Derek Cedillo, a mechanical engineering senior from Tenley Park, Ill.; Laura Dilley, brain and cognitive science junior, Independence, Mo.; Anna Lukasiak, civil engineering junior, Jersey City, N.J.; Moshe Matsa, math junior, Armonk, N.Y.; Rosanne Rouf, electrical engineering and computer science junior, Glen Carbon, Ill.; Amy Swanson, mechanical engineering senior, Richfield, Minn.; Annia Yiu, mechanical engineering sophomore, Miami, Fla.; and Kwong Yung, physics senior, Fairfax, Va.

Mary E. Burke, the former program manager of Class Giving, provided this list and more detailed information on two of the recipients, both majoring in mechanical engineering.

Annia Yiu was born into a large extended Chinese family in Costa Rica and came to Miami, Fla., when she was a young schoolgirl. She is a member of the Society of Women Engineers, where she serves on the executive committee. She enjoys intramural sports, especially soccer, basketball, and softball, and is active in the management of her dormitory, McCormick House. Annia has also joined Kappa Alpha Theta sorority and has gotten involved in many community service projects through the sorority. She also participated in the MIT Alumni/ae Telethon and enjoyed making contact with MIT graduates. Last summer she returned home to Miami and waitressed in a Chinese restaurant.

Amy Swanson received a Class of 1938 Scholarship for the third year in a row. She has an outstanding academic record and hopes to land a job upon graduation in some area of

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manufacturing. Outside the classroom, Amy is a member of the varsity women's crew and she plays intramural soccer. She is also very musical, sings with the MIT Concert Choir and plays the piano. Amy is active in the Society of Women Engineers and the MIT Chapter of Campus Crusade for Christ. In her spare time, she enjoys writing and photography.

As you can see, your contributions to the Class of 1938 Scholarship Fund are helping a number of highly deserving students.

Your class secretary is approaching the end of his first year of compiling Class Notes. One of the biggest frustrations is acquiring death notices in a timely fashion. I would appreciate hearing from anyone as soon as you see or hear of such an event. Apparently in too many cases, everyone feels that someone else will do the communicating. All too often, the first notification is to the Alumni/ae Association by the lawyer of the deceased at a relatively late date. I would hope that our class grapevine can speed up information for the Class Notes. Please remember that nothing gets into the Class notes that is not compiled by your secretary, and I cannot submit anything unless you provide it to me. I thank all those who have sent me material and hope that the coming year will include many more contributors of items of interest to all of us.—Paul R. Des Jardins, secretary, 6251 Old Dominion Dr., Apt. 310, McLean, VA 22101-4807; tel: (703) 534-4813; Gretchen Birge, assistant secretary, 233 Carroll St., Apt. 202, Sunnyvale, CA 94086-6264; tel: (408) 736-5011

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The Katherine Dexter McCormick ('04) Society honors 24 '39ers: Pete Bernays, Philip Bush, George Cremer, Virginia and Richard Donohoe, Charles Freyfogle, Fred Grant, Jean and Michael Herasimchuk, John Herlihy, Yolande and Ernest Kaswell, Marguerite and Leonard Mautner, Hazel and Walter May, Louise and Charles Mercer, Manning Morrill, Harold Muckley, William A. Murphy, Norma and Morris Nicholson, Robert Saunders, Anne and Frederick Schaller, Hilda and Harold Seykota, Dana and Paul Stanton, Alyce and Winthrop Steele, Arthur Vogely, and Helen and Arthur Zelding. Other '39ers who especially appreciate sharing McCormick Society benefits may contribute through Denman K. McNear, '48, Chair, c/o MIT Office of Individual Giving.

Lieutenant Commander Eric F. Howlett earned a BS at the University of Pennsylvania and an SM in operations research in 1991 at MIT Sloan Graduate School. He is the engineering officer of the Ohio Class Trident submarine USS *Georgia* (SSBN 729), with homeport at Bangor, Wash. He invited MIT alumni/ae to tour his submarine. About 70 alumni/ae accepted and were thrilled by what they saw.

Commander Howlett drove us around the base at Bangor. After orientation on the submarine's deck, we descended 35 feet on its ladders and walked through much of its 560-foot length. For two hours, he answered all questions on non-classified topics. None of the internals were masked and we saw everything except the nuclear works. We were fascinated and impressed by his mastery of the function, operation, and maintenance of equipment

used by the 1,570-man complement. We stood between the twin periscopes in the main control center and looked at all the control panels as we listened to his explanations. At tour's end—three days before my 79th birthday—we climbed 35 feet of ladders and disembarked.

We are grateful to Commander Howlett and his commanding officer, Captain Ralph Heston Stoll, for treating us to the sights and introducing us to the submariners' mission: to maintain world peace through strategic deterrence.

Dave Morgan made an unusual response about nuclear submarines. I had phoned him for news and mentioned our tour of the USS *Georgia*. Dave said he had an experience with the *Georgia* and its sister subs. For years, Dave owned and operated Peerless Precision Products Co. Dave said: "... we contracted to do very high-precision making of parts on those twin periscopes between which you and Hilda were standing on your tour..."

Hazel and Walt May moved to a free-standing house within a development administered as a co-op. The residents were quick to elect Walt to their board and now they benefit from administration of the caliber that made the Mack Truck Company great. The Mays plan travel including a transatlantic cruise on the *Queen Mary*, passage through the new tunnel connecting England and France, and return to the USA on Hazel's first ride on the Concorde supersonic jet.

Betsy and Bob Withington are about to attend the 60th anniversary of Bob's graduation from Exeter. While at Exeter, they may see Lucille and Oz Stewart. It turns out that Oz and Betsy were classmates from kindergarten through 8th grade, and Oz and Bob were classmates at Exeter before they became classmates as MIT '39ers.

Jean and Joe Dana have good news. Joe's fall on a tennis court caused his temporary vacation. He recovered so rapidly that he and Jean joined Adie and Bill Pulver for skiing at Aspen. After that, the Danas cruised 10 days around the Virgin Islands. In between times and at meetings of the MIT alumni/ae on Cape Cod, the Danas see Pam and Bob Pratt, Beatrice and Burns Magruder, and Muriel and Smitty Curtis.

Martha and Ted Wroblewski play tennis three times a week in Danvers. He still is being asked by longtime clients to consult on his electrical engineering specialties. When I phoned, he was preparing to attend ceremonies at MIT honoring the Sustaining Fellows.

Charles Ryder graduated in civil engineering, then felt his destiny to be in medicine. He earned MD and PhD degrees, and became a professor in New York on the Columbia Presbyterian medical faculty. He specialized in orthopedic surgery, children's pediatrics, wrote technical papers and addressed medical conventions. Now retired in Tenafly, N.J., he is active on school boards and enjoys coaching and administering the 4k4-team soccer league of school-age youths.

Aletta and Bob Touzalin redecorated their Naples house. They hosted Yolande and Ernie Kaswell who called on them during a recent tour of southern Florida. ... Jean and Bob Schmucker visited the Touzalins before moving into an apartment on Siesta Key near Sarasota. Lucille and Phil Stoddard, '40, live in Fort Meyers, Fla., and visited the Touzalins

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recently, but their reminiscing didn't cover who finally won the Ping-Pong championship at Phi Kappa Sigma. By now, Bob and Aletta are in England on their 15th annual trip. They'll boat on England's canal system. Eugenia and Fred Cooke will join them for three weeks.

Frances Emery Wypler relayed a news clipping about the death, on December 3, 1994, of William Egler Haible. William achieved fame as an architect and details of his career were in '39er notes in the May/June 1995 edition. Thank you, Frances, for your thoughtful relay.

Judith and Henry Littlejohn write: "We enjoyed sailing the Lesser Antilles on the new brigantine *Lili Marlene* through the MIT Alumni/ae Travel Program. Meeting other alumni/ae and visiting six islands while sailing from Martinique to Antigua was especially enjoyable. The French cuisine and weather were fabulous. The superb crew on the meticulously reproduced brigantine combined to make a great adventure for us."—Hal Seykota, secretary, 2853 Claremont Dr., Tacoma, WA 98407

40 Marshall McCuen writes from Indianapolis, Ind., that he cannot make the 55th Reunion as he has two hip prostheses that give him a lot of pain and keep him confined to a wheelchair, with an occasional excursion on crutches. He also says, "All my working life was for General Motors, retiring 17 years ago after 38 years in engine design, development, and production, both aircraft and autos. In retirement, we have never thought of moving from Indianapolis—none of this sun-bird stuff for two ex-snow skiers. I have to say 'ex' because my hip operation forced the end of our favorite sport. In retirement, I have filled most of my time with volunteering. Always have kept working on the Educational Council—have interviewed students for MIT admissions for 35 years. I've been active in SCORE for 16 years, a Republican precinct committeeman for 19 years, active in Meals on Wheels for 11 years, to name some of my volunteer

activities. Sorry I won't see you in June."

William L. Sweet of Fort Wayne, Ind., died recently. A native of Yonkers, N.Y., Bill went to Fort Wayne shortly after graduation to start up the Supercharger Division of General Electric. He left GE to work at the Magnavox Corp. in the mid-1950s. He later started his own consulting firm, W.L. Sweet & Co. He was elected county surveyor in 1964 and retired in 1987. He was the Republican precinct committeeman and ward chairman.

Robert Blake, '41, sent an article from the *New York Times* describing the safety audit by ASAIR, as a result of a crash in September 1994. The \$1 million audit was performed by PRC Aviation, of which R. Dixon Speas is president and co-owner. Dixon has been a nationally known aviation consultant for 45 years, heading PRC Aviation and two predecessor firms after spending ten years as an engineering executive with American Airlines.

David R. "Beano" Goodman sent me another of his autobiographical sketches entitled, "A Disorderly History of Madison Chemical Co." It kept me laughing out loud all the way through.

As a result of the 55th Reunion, I hope there will be lots of news items for future columns. In any event, please keep those letters, phone calls, and monographs coming to Richard E. Gladstone, secretary, 250 Hammond Pond Pkwy., 12055, Chestnut Hill, MA 02167-1528; tel: (617) 969-5161.

41 55th Reunion

Please send news for this column to: Charles H. King, Jr., secretary, 7509 Sebago Rd., Bethesda, MD 20817-4839; e-mail: <olspaceman@aol.com>

42 These are the last notes for this year being written from our winter home in Clearwater, Fla. We're packing and will soon trek back up north to Tarrytown, N.Y.

Howard Evans who retired from his work as a research chemist for the U.S. Geological Survey in Reston, Va. last year sent a "personal message" for our Class Notes. Here it is, verbatim:

"It's a good time for me to touch base with the Class of '42 after a long silence. I retired last April (took the buyout and ran!) after 42 years with the U.S. Geological Survey. When I joined in 1952, the Survey was gearing up for the search for uranium, and money poured in from the AEC. My crystal chemistry group (shared with Charles Christ) flourished (over 350 publications in 40 years) until recently when the Survey seems to have lost interest in crystal chemistry altogether. Two of the most exciting times I remember: one when we were deeply involved with Herbert Hauptman and Jerome Karle in development of X-ray diffraction intensity statistics for crystal structure analysis, and the other; when the first lunar samples from *Apollo 11* arrived in our laboratory. I now divide my time between the Survey as emeritus and the Smithsonian Institution—and take Fridays off. Also pleasant to take more time working on our Frank Lloyd Wright-

designed house and half-acre of gardens."

Two obits: Bob Vyverberg, Course VIII, of Pittsford, N.Y., died on February 22. He retired from Xerox Corp. and I remember coxing a crew on which he rowed. Don Stansfield, Course I, of Marlborough, Conn., died on February 16. He also had earned an MCP in 1948, and was retired from the New Jersey Division of State and Regional Planning. Our sympathy to the families.—Ken Rosett, secretary, 281 Martling Ave., Tarrytown, N.Y. 10591

43 My thanks to those classmates who sent sympathetic comments about the April tragedy in Oklahoma City. When the horror has receded, what will be remembered is how, in the disaster's aftermath, our public agencies, private institutions, and individual citizens rallied magnificently to the task of rescue and relief. Bob Caldwell, Steve Heller, and the Alumni/ae Association have sent much additional detail about the life and career of Bob Hewes, who died February 14. Having reported this event in the July Class Notes, I'll mention only the impressive program for the February 18 memorial service at Eckerd College in St. Petersburg, Fla. He was obviously held in high regard.

Steve also sent some personal news from Dayton, Ohio, about himself and Bob Caldwell. The Hellers visited the Caldwells in Gulfport, where Bob is involved in building and real estate development. His son is also a builder, and one daughter is in the Caldwell real estate business. The other daughter is married to an architect who does some work for the in-laws. Nepotism isn't all bad.

After their sojourn in Florida, Steve and spouse sailed through the Panama Canal on an 80-passenger cruise ship. On this trip they ran into Kay and Hank Walcott (Course V), Aft Aronson, SM '53, and Herman Miller who had been a World War II Navy grad student in Course XIII. The occurrence of six MIT connections in a population of 80 is certainly remarkable.

Another obituary reports the death, on February 21, of Raymond R. Richards in Milton, Mass. Raymond was born in Cleveland, Ohio. Following World War II service as a Marine Corps captain in the China-Burma-India theater, in 1946 he joined the Koehler Manufacturing Co. of Marlboro, Mass. He retired in 1986 from his positions as executive VP and treasurer of Koehler. At MIT, Raymond was a member of Tau Beta Pi, and later belonged to the MIT Club of Boston. For 32 years he served as treasurer for the Lutheran Church of the Good Shepherd in North Quincy, and also served on the church council. We extend our condolences to his wife, Randi, and to the other members of his family.

From Salt Lake City, Dick Zeamer reports that he is living a good but busy life, involved with an engineering business, real estate, studying, and writing. He likes to study and analyze civilizations as engineering problems—what he calls the "mechanics of history." He believes the insight gained can be used to modify civilizations for longer life. He belongs to a number of intellectual societies, as well as the Wasatch Mountain Club (skiing and hiking). He also enjoys visiting numerous

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family and friends, scattered from Britain to California. *Carpe diem*, Dick.

George W. (Bill) Potts writes from Leesburg, Fla., that they have an Orlando MIT Club up and running. Events have been well attended so far, with meetings in such exotic settings as the Splendid China. After living in the South China Sea area, and dining at great restaurants in Taiwan and Hong Kong, Bill declares the Splendid C. serves an excellent meal. The 2 percent of the surviving class members who live in the Leesburg area load up a couple of cars and attend as a group. The next scheduled meeting is on a fishing boat, hoping to hook some marlin off the coast near Cape Kennedy.

Thanks again for the letters. They are what justify my job.—**Bob Rorschach**, secretary, 4727 S. Lewis Pl., Tulsa, OK 74105-5138

44

When you were a small boy and didn't feel well, the advice of the day was "did you take your Lydia Pinkham this morning?" Thereby hangs a tale. Lydia Pinkham

(1819–1883) was an American feminist and manufacturer of a patent medicine, L.E.P.'s Vegetable Compound, which earned millions of dollars. Lydia Estes was born near Lynn, Mass., on February 9, 1819. She was a member of the Female Anti-Slavery Society and a friend of Fred Douglass and other reformers. In 1843, she married Isaac Pinkham. The panic of 1873 ended Isaac's real estate speculation and left the family destitute. In 1875 Mrs. Pinkham began to market a home remedy for disorders of the female reproductive system, which she had given to neighbors for years. The compound consisted mainly of unicorn root, pleurisy root, and alcohol. It grew popular with women, many of whom were reluctant to consult male doctors. Her sons promoted the product energetically. Sales bloomed even after the alcoholic content was reduced to save money. Medical science found no therapeutic value in the ingredients. In her advertising and correspondence, Mrs. Pinkham dispensed advice on medical matters. She died in Lynn on May 17, 1883. Two full scholarships were funded by the Pinkham Foundation for graduates of the two high schools of Lynn, Mass. **Andrew Corry** was a recipient of one of these. Many times over the years, Andy relates how he could never have been able to afford to attend MIT if not for the Pinkham Scholarship. After the war he told the foundation that the GI bill would cover the remainder of his educational costs, he no longer needed their aid and to give it to someone else. They told him to come back if he had any unmet need. So there, if you don't feel well today, don't forget to take your Lydia Pinkham remedy.

From Westport, Conn., **Paul Heilman** sends word that after the 50th he had the idea of getting together with some local classmates at a nearby restaurant for an occasional lunch. He culled the names of men nearby from the 50th reunion book and phoned them. They have had two reunions so far and the fellows who

have come to one or the other to date are:

Holton Harris, Rafael Laredo, Gonzalo Docal, John Gardner, Bob Meny, and Art Dershowitz. If he has missed anyone in the area who would like to join the group, they can call him. He is in the Westport phone book.

Don Arsem up in Snyder, N.Y., sends the following notes: Three of us, all in the original Class of '44, **J.W. "Jim" Mavor** (Course XIII), **W.M. "Bill" Wallace** (Course II), and **Don** (Course VI) arranged to meet at the MIT reunion luncheon to celebrate an unusual milestone. The three grew up together and had been good friends in Schenectady, N.Y. In various combinations, they were in the same class in grade school, junior high and high school. They went to MIT together but in different disciplines. They didn't have much contact over the years, but the reunion was helpful in renewing their old long-standing friendship. At the reunion, Don learned that **Will Rodeman** lives near his summer place in Maine and next summer will take up Will's invitation to sail into his harbor of Round Pond.

Joseph J. Snyder, 87, of Manchester-by-the-Sea, who served 25 years as treasurer and 24 as a VP of MIT, died February 28, 1995, of congestive heart failure after a long illness.



50TH REUNION MARSHALLS **CHRIS BOLAND** (LEFT) AND **CLINTON SPRINGER** ON COMMENCEMENT DAY

Mr. Snyder was responsible for both the stewardship of MIT's financial assets and the management of its investments, as well as for the Institute's financial operations and financial relations. He also managed the handling of contractual arrangements for MIT's large volume of government research, becoming recognized as one of the leading university financial officers in the nation. More than 40 years ago, Mr. Snyder began to accumulate reserve funds to protect MIT against what he saw as the fiscal uncertainties associated with having a large portion of the Institute's revenues dependent on government-sponsored research. Mr. Snyder's vision was saluted by **Glenn P. Strehle**, '58, MIT's VP for finance and treasurer, who succeeded Mr. Snyder in that post. "What he saw coming certainly arrived," Mr. Strehle said, speaking of the changes in federal research support, "and thanks to his initiative

ClassNotes

in the 1950's, the Institute is better able to deal with the post-Cold War world of the 1990's." When Mr. Snyder retired in 1975, **Howard W. Johnson**, then chairman of the MIT Corporation, said the university was "indebted to him for more than a quarter century of wise and prudent stewardship of our financial investments and fiscal affairs. Mr. Snyder continued serving MIT as Life Member of the Corporation. He became Life Member emeritus in 1983.

A native of Findlay, Ohio, Mr. Snyder was born in 1907. He graduated from Carnegie Institute of Technology in Pittsburgh (now Carnegie-Mellon University) in 1931. In 1934 he earned the MBA at Harvard University. He was associated with Colonial Management Associates, Inc., a registered investment adviser and its predecessor companies from 1934, and served as a director from 1945 to 1974. Mr. Snyder was a trustee of Boston Five Cents Savings Bank and a director of Liberty Mutual

Insurance Companies and Arthur D. Little, Inc. He was a member of the American Academy of Arts and Sciences, the American Institute of Chemical Engineers, and the Boston Economic Club. He earned a chemical engineering degree from MIT in 1944. Mr. Snyder joined MIT in the early days of WWII. The now-famous Radiation Laboratory, where radar was developed, was just gearing up and Mr. Snyder became a member of the lab's Office of Business Administration. That work brought him into contact with **Horace S. Ford**, '31, then treasurer of MIT, who recognized his young colleague's potential. When Mr. Ford approached retirement, he recommended Mr. Snyder as his successor. He was appointed assistant treasurer in 1946 and was elected treasurer in 1950 when Mr. Ford retired. On April 3, 1937, he married **Helen Torrance Colburn**. In addition to his wife, he is survived by two sons, **Clinton J. MacGeorge** and a daughter, **Susanne C. Rappaport**. The class extends its sympathy to his family.

Please send in items of your activities.—Co-secretaries: **Frank K. Chin**, 221 St. Paul St., Brookline, MA 02146; **Louis R. Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to:
Clinton H. Springer, secretary
P.O. Box 288
New Castle, NH 03854

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50th Reunion

Please send news for this column to: **Ned Tebbetts**, secretary, 9 Jerusalem Road Dr., Cohasset, MA 02025-1110; tel: (617) 383-1662

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Claude Brenner writes to tell us that the Institute has selected the second Class of 1947 Career Development Professor. She is Evelyn M. Hammonds, SM '80, assistant professor of the history of science in the Science and Technology Program. Professor Hammonds received a BS in physics from Spelman College and a BSE in EE from Georgia Institute of Technology. After earning a master's in physics at MIT, she received a PhD in the his-



EVELYNN M. HAMMONDS
CLASS OF 1947
CAREER DEVELOPMENT PROFESSOR

tory of science from Harvard. She was appointed to the faculty here in 1992. Professor Hammonds is the author of numerous essays and articles, and has received both local and national awards for her writing.

Our first Career Development Professor, Michael I. Jordan of Brain and Cognitive Sciences, was promoted to associate professor with tenure last year. Professor Jordan spoke to us at our 45th Reunion banquet in Maine in 1992. He told Claude that the support of the Class of 1947 Chair helped him enormously in his research.

We just received word that **Edmund Ritter** died in January in Natick, Mass. He had been a designer of aeronautical and space guidance systems for Raytheon until his retirement in 1975. He served in the U.S. Navy during World War II and was chief of engineering aboard the USS *Witek*, a destroyer that participated in the early sea trials of radar. He was an avid sailor who enjoyed racing small boats and cruising the waters of New England. He was a member of the Country Club in Brookline, the Society of Colonial Wars, and the Pennsylvania Society of *Mayflower* Descendants. He is survived by his wife, Priscilla; a daughter, a sister, and a brother.

Here's a call for volunteers! We are now starting planning for our 50th Reunion in 1997 and can use help. Anyone who can help should write Claude Brenner, 30 Preston Rd., Lexington, MA 02173-3227.—R.E. (Bob) McBride, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

48

Dick Harris merged his company, Curtis and Marble, with Transtechnology in 1980. He spent three years with the merged organization and stopped working in 1983. As a private investor, he spearheaded some investment banking deals after that. A year ago he became a trustee of the Society for Preservation of New England Antiquities. The Society has 40 museums, 44 stewardships, and over 100,000 artifacts under its care. Dick and his wife, Rosie, have lived in the same house in Grafton, Mass., for 42 years. They have seven grandchildren. Dick enjoys doing projects and has built stone fences on his property. Most days Dick has lunch at the Worcester Club with a group of friends in situations similar to his. They enjoy testing one another's memory for the latest news.

Warren King and his wife, Jean, attended an event at MIT honoring him and other Sustaining Fellows. A plaque identifying the MIT Sustaining Fellows was mounted outside of Room 10-250. Warren and Jean had a great season this past winter at their desert home in Rancho Mirage, near Palm Springs. As part of their trip to MIT, they visited their grandchildren in New Hampshire and Vermont. Another son has been transferred to the VA Hospital in West Palm Beach, Fla. They plan a visit to him before leaving on the *QEII* for Europe.

Irwin Lebow writes to share his activities. He has been involved in one way or another with communications and information processing, first at the Lincoln Laboratory, then in government and industry. For the last eight years, he has been an independent consultant and writer. About four years ago, he published a book, *The Digital Connection*, explaining to laypeople what the digital world is all about. This past March he published *Information Highways and Byways: From the Telegraph to the Twenty-first Century*. This book, also for the general reader, traces the history of electrical communications from the time of Morse in the 1830s to the present, providing insight into today's rapidly changing information industry.

Our contributions to MIT at the time of our 40th Reunion are used to fund the Class of 1948 Career Development Professorship. MIT's provost, Mark Wrighton, wrote to announce the selection of Professor Anne M. Mayes as the next holder of our class's professorship. Professor Mayes received an SM in materials science and engineering from MIT in 1986 and a PhD in materials science and engineering from Northwestern University in 1991. She was appointed assistant professor of polymer physics in MIT's Department of Materials Science and Engineering in 1993. She is the author of numerous publications and has received several awards for her research, including the National Science Foundation Young Investigator Award in 1993.

The provost wrote, "For a young, non-tenured member of the faculty, appointment to a career development chair provides much needed encouragement, freedom, and visibility at a critical time in his or her academic career, when creative and intellectual powers are near their peak and professional pressures are greatest."

Ken Brock's wife, Ann, had a hip replacement last year and is back to playing tennis two-to-three times a week. She appreciated

Bill Zimmerman's comments made before her operation suggesting that she would be back to playing tennis. Bill also was able to continue playing tennis after his hip replacement.

Emerson Callahan has made a gasoline additive many times and observed an increase in the gasoline mileage of his car. While making the latest batch in a kitchen blender, he started a fire that charred his basement. He had poured gasoline, water, and an emulsifier into the blender. When he added a polymer he had not used previously, the mixture exploded. In his haste to escape, Emerson knocked over a five-gallon can of gasoline that fueled the fire and set his shoes ablaze. With smoke billowing behind him, he reached the kitchen and doused the flames on his shoes in the sink. Meanwhile the fire in the basement had become hot enough to melt the copper joints of the water pipes. It "un-sweated" the joints, but then the pipes acted as sprinklers and the water helped to contain the fire. Emerson and his wife, Virginia, ran to the front door, which was secured by two deadbolts, but couldn't open the door. They broke a diningroom window and crawled out. Emerson had burns on his face, feet, and hands requiring a visit to the hospital. Virginia had cut her leg while escaping through the window, and she required treatment also. Firefighters were there quickly and the blaze was out in 10 minutes, but the basement was severely damaged and there was smoke damage throughout the house.

Neil Helmers is living on the Cape and is active on the Long Range Planning Committee for Falmouth. He previously served with distinction on the town's planning board.—**Marty Billett**, secretary, 16 Greenwood Ave., Barrington, RI 02806; tel: (401) 245-8963

49

On March 18, 1949, the stage at Cambridge High and Latin School reverberated to that year's version of the Tech Show. Among the many who worked for months to insure

the success of the undertaking were: **Art Van Stolk**, author; **Bill Katz**, '48, composer and musical director; **Jim Berman**, general manager; **Frank Hulswit**, producer; **Bob Abelson**, '48, director; and none other than **Oscar Hammerstein II** of *Oklahoma* fame. In a letter to Provost of the Arts **Ellen Harris**, **Bill Wilson**, general manager of the MIT Musical Clubs in 1949 proposes that the Boston Pops play a medley from the show at our 50th Reunion in 1999. (Bill's idea prompts a few questions: How do you get a medley written even assuming you can find the original notes? And how do we finance such an undertaking?) Bill comments: "In 1949, Oscar Hammerstein II headed a business that did musical orchestrations, arrangements, compositions, etc. I believe he had an office in Boston at that time. Oscar attended the 1949 Tech Night at Pops in Symphony Hall. I know this because I arranged for his tickets and personally handed him the check (\$1,000) for his services at intermission. He is the same gentleman who wrote the lyrics for many hit musicals including *Oklahoma*." And the hope is that, buried somewhere in the BSO archives, the orchestrated music for our show still exists. Let us all hope hard on this.

Two weeks ago, my phone rang and who should be on the other end but **Harvey Tuck**

way out in Dayton, Ohio. Harvey had seen my note in the May/June issue about the possibility of a mini-reunion in Puerto Rico in 1996 and was calling to voice his enthusiasm for the idea.

James A. Bierlein, a chemical engineering consultant working out of his home in Kettering, Ohio, died on November 12, 1993. I regret the absence of further information but, speaking for the class, extend our sincere condolences to his family.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

50

After touching base with **John Mills** in England last October, I proceeded antipodally to New Zealand where **Don Eberly** has lived for the past year near Wellington. Don

moved there, after 25 or so years in Washington, to be near his daughter and grandchildren. This was not his first venture overseas. The draft swept him into the Korean War and made a lifetime impression. He concluded that there ought to be an additional way to serve one's country through national service. When the military let him go he went on to teach in Nigeria and Istanbul. After receiving a master's from Harvard, he returned to Nigeria as undersecretary for education. In 1964, he joined Education and World Affairs, a group devoted to strengthening the international viewpoint in U.S. education. In 1966, he convened a conference on his favorite subject, national service. It got front-page attention from the *New York Times* and notice by President Johnson, who had a similar interest since the 1930s. Don served under Johnson and then Nixon, for whom he worked on Action, a federal volunteer program, for which he ran a pilot program in Seattle. In the 1980s he joined the Selective Service which asked him to set up an alternative service program (aimed at conscientious objectors) as opposed to national service, which would be for everyone. Don then began consulting on the subject with funding from the Ford Foundation, among others. A year ago he semi-retired and moved to New Zealand. He still keeps an interest in national service and will take part in a conference on the subject in Israel in June (I write this in May). Not your typical MIT engineer's career, I would say. Nice going, Don.

Moving on, I found **Ian Lloyd** who has lived in Sydney, Australia, for over 40 years. Ian came to MIT from New York City with a cosmopolitan background. His Canadian father, a physician, met his mother, an Australian, in France where Ian was born. The family moved to New York where his father began a practice. Ian worked briefly as a city planner after graduation from MIT, but in 1951 he moved to Australia, where several of his mother's family still lived. Ian has spent the last 40 years in real estate, mainly apartments and a residential hotel. He is now semi-retired and has two sons, one in Singapore and the other in Italy.

On the way back I talked to **Myles Spector** in Los Angeles. You all remember Myles as one of the group that set up our very successful Class of 1950 Student Aid Fund. After receiving a Harvard MBA and success in electronics, teaching equipment, and venture capital, Myles set up a company dealing with show business clients. Myles has clients worldwide, and I caught up with him just before he

was leaving for Paris.

Norm Champ called recently and said that he and Judy traveled from Bangkok to Singapore on the Eastern Oriental Express. He brought back the news that in Singapore, a slap on the wrist is done with a machete. Norm reports that Cathay-Pacific treats its passengers very well.

I received a letter from **Warren Poneman**. He writes that he is moving to Scottsdale, Ariz., "for some sun and fun" after retiring from the companies he ran in New Jersey (Lamtex and Autonumerics) and a consulting practice. At Lamtex he "had an overload of MIT graduates" which included his classmate and partner, **Jonas Medney**. Warren looks forward to joining the local MIT Club. . . . **Tom Wilson** sent a note from Pasadena where he has practiced architecture. He has many projects resulting from the 1994 Northridge earthquake—relocation and restoration projects. He just completed a library for a private client. He enjoys attending MIT Club of Southern California events. . . . **Don Harnsberger** writes from The Woodlands, Tex., that he moved there in 1993. He had spent 1964–1980 in England and Germany with Cooper Industries (power and compression equipment for the oil and gas industries). Don then spent 12 years at Princeton's Plasma Physics Laboratory, whose mission is to develop practical fusion power generation. Don has built his own airplane which he first flew in 1984. . . . **Serge Wisotsky** writes that he is working on subseabed disposal of high-level radioactive waste by pile driving into million-year-old sediments at water depths of three miles.

I just received a note sent early in the year by **Ken Eldred**. He and his wife, Barbie, were planning to sail in February for a three-month cruise of the western Caribbean. . . . You are all familiar with the UPC scanners at the supermarket checkouts that beep for each item and maybe even charge you the correct price. **John Esserian** was a key player in creating this system. In 1957 John envisioned a computer driven check-out system. In 1960 he formed a character recognition firm called Charecogn. Charecogn developed a system using a handheld scanner and a bar code with the information in a circular format (called the Sunburst Code). In 1970 he did a demo of his system with Virginia Knauer of the Nixon administration. This set off a technological competition which resulted in the 1973 announcement of the now familiar rectangular UPC, knocking John's Sunburst Code out of the race. (Just think, with a little luck our class might have been able to take credit for the Boston Bar Code.) John's company, now renamed Second Dimension Data, continues to look for applications of his technology.

Since my last column I have learned the sad news that **Herb Miller** died in January. Herb lived in Brookline and made his career in electronics engineering. He was a senior member of the IEEE and a trip leader in the Appalachian Mountain Club. . . . In April, **Charlie Levy** called to say that **Louis Mager**, also of Brookline, died in March. You are all familiar with **Bob Mann's** work on prosthetics called the Boston Arm. In 1973, Louis founded Polymer Technology Corp., a leading developer of contact lens plastics and solution systems known as the Boston Lens. Along with ophthalmologist Perry Rosenthal, he solved the dilemma of hard versus soft contact lenses.

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Hard lenses were more comfortable and better optically, but were not oxygen permeable leading to the eye eventually rejecting the lens. Soft lenses were less comfortable and more prone to infection. By switching from polymethylmethacrylate to silicon methacrylates, Louis and Dr. Rosenthal were able to make an oxygen-permeable hard lens. This development allowed hard lenses to remain a part of the contact lens business. Louis is survived by his wife, Hyla (Kim) Mager.

Shortly before the deadline for this column, Bob Mann forwarded to me the following letter to him from Jack McKenna:

Dear Bob,

Please accept my resignation as secretary to the Class of 1950. Because of the difficulty I have had in reading and writing since my stroke, I can not carry out the function of this office. I have enjoyed the years I have served in this capacity, and working with you and other class members has been a special pleasure.

I am very grateful to Bob Snedeker for taking over when I was ill and I do hope he will accept the nomination as secretary and continue to serve. He has added his own personality and humor to the Class Notes, and everyone has enjoyed them.

Regretfully,
John T. McKenna

Jack's very gracious letter calls for more than a hasty reply. I have gone on too long in this column, so next issue I shall try to frame a suitable reply, and I promise to be brief, terse, concise, pithy, trenchant, succinct, meaty, and maybe laconic. Thank you, Roget.—**Robert A. Snedeker**, acting secretary, Seven Mashie Way, North Reading, MA 01864; tel: (508) 664-1738; **John T. McKenna**, secretary, P.O. Box 146, Cummaquid, MA 02637

51 45th Reunion

Let me start with the first bit that I have to pass on to you about our forthcoming 45th reunion. It is only 12 months away, but why procrastinate. Fred Ezekiel and I attended a meeting held by the Alumni/ae Association to provide advance notice of a significant change that will be introduced starting in 1996. The MIT administration and faculty have decided to elongate the semester year. One result is that graduation, normally held during the very first days in June, will now occur in the second week of June. This is the period when the class reunions are normally held. Starting in 1996, the graduation and the reunions will occur concurrently. Fitting these major events together required some changes to the reunion schedules. One major shift is that Technology Day, always a Friday event, will be held on Saturday. The current schedule for on-campus Tech Week is:

Thursday, June 6: Tech Night at the Pops
Friday, June 7: Commencement/evening class events

Saturday, June 8: Technology Day/evening reunion events

Sunday, June 9: Techsas BBQ/Tech Challenge Games

These changes will provide our forthcoming reunion committee, chaired by Fred Ezekiel, with

many new challenges. I am sure they will be met and we will be provided with the same high caliber reunion that we have enjoyed in the past.

In the next month's notes, I hope to have some coverage of some of the exciting progress being made in projects that our class fund for Excellence in Education has been supporting.

In a much too modest letter, Frank Heart wrote of his recent retirement and very impressive career at Bolt, Beranek, and Newman. He retired from the position of president of the BBN Systems and Technology Division which has about 1,200 employees. Frank became involved with computers as an undergraduate at MIT using their pioneering Whirlwind computer. He went on to join BBN heading their now very famous project developing the Arpanet. The Arpanet, the direct forerunner of the Internet, is celebrating its 25th anniversary. Frank mentioned the gratifying celebration held at BBN honoring this anniversary. He modestly didn't discuss much of his being the father (maybe grandfather) of the Internet. This development should possibly be recognized as the most socially significant benefit that we will derive from computer technology. Internet provides us with ready access to a worldwide scope of knowledge and places us in direct contact with millions the world over. It opens the doors to learning and interaction among people on a global basis. Its social impact should be thought in terms of our age's counterpart of the Gutenberg Bible. It must be so very rewarding to Frank that he played such a central role in this achievement. Much of the content of Frank's letter was devoted to his family. Jane, his bride of 35 years, is a retired high school math teacher and is now doing volunteer work. They have three children. Bennet is an attorney working in the Attorney General's office. Rachel, a veterinarian, works with racehorses. Simon, an environmental engineer, is working on wastewater issues and environmental regulation. Frank has lived in Lincoln since 1962. Since leaving Lincoln Labs, he has maintained contact with MIT as a Sustaining Fellow. Let me end with a quote from Frank's letter: "Looking back at my MIT education, and the fortuitous fashion in which I encountered computers (Whirlwind) in the late 1940s, it is nearly certain that I could not have had anything like the same career success at any other place. MIT is truly a wonderful place."

Robert Blake, '41, kindly sent us a note of his meeting with **Richard C. Blanchard** and his wife Barbara at an elder hostel in Oregon. They are fine and would take daily walks of several miles along the beach at Lincoln City accompanied by a professor of coastline ecology. The Blanchards were last seen in Portland making arrangements for a river cruise up the Columbia and Snake Rivers.

Heavily into church work, **Robert C. Lewis** is enjoying square dancing in warm and sunny Florida.

We received the sad word of the passing of **William H. Ramsey** in January. He was director of engineering special programs at MIT. Prior to his position at MIT, he was a VP of Ault, Inc., in Minneapolis and an associate director of the Institute for New Enterprise Development, a venture capital firm in Belmont, Mass. He was a board member for the Massachusetts Society for the prevention of cruelty to children and a former president of the board of the City Mission Society in Boston. We extend our sin-

cerest condolences to his wife, Charlotte, his son, Marc, and daughter, Lynne Clark.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

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I don't know how I could have done it, but I managed to lose a press release announcing that the Society for Manufacturing Engineers has chosen **Swraj Paul** for an award.

Since I am relying on my memory, this report may have more verisimilitude than accuracy. I



Swraj Paul

have retained the impression that the award was in recognition for his ability to take a humdrum, run-down manufacturing business and increase its sales and profits, with a firm making welded steel pipe that he acquired several years ago being cited as an example. Apparently it is easier to get an MBA than to manage a business well. . . . If Swraj Paul finds opportunity in manufacturing, **Dan Lufkin** has found it in translating Germanic language documents into English. He has developed a part-time occupation he has followed for a long time into a full-time career since he retired from Fairchild Space two years ago. He is now in the pleasant position of having more business than he really wants so that he can afford to be choosy. Since he mentions that his work last year included translating 1,200 pages of Swedish documents on disposable diapers, he does not appear to be excessively particular. Dan's wife, Pat, is a freelance editor, and together they have published translations of half a dozen books on surveying, geodesy, and remote sensing from German. At the time he wrote to me, he was looking forward to taking a few long bicycle trips this summer as a respite from work.

Steve Spacil made a more drastic break with his past life when he retired from GE two years ago. He and his wife moved to St. Croix, Virgin Islands, where they had built a house. Now well settled in, Steve says that he is studying Spanish and volunteering at the local botanical garden, where he has learned enough botany to serve as a docent for groups of tourists from cruise ships, and to apply his engineering talent to maintaining its electrical and plumbing systems. Because he also works with an historical group, he has recognized a need for a short-run publishing facility, and is looking into starting a business to print specialized publications one at a time using a laser printer. . . . **Arthur Martin** has solved the problem of a retirement occupation by not retiring at all. He continues to serve as a stockbroker at Paine Webber's office in Princeton, where he has the title of senior VP of investments. He and his wife have lived in nearby Belle Mead for nearly 30 years, and he says, ambiguously, that they have four grandchildren that they enjoy.

In anticipation of my own retirement, I am changing my e-mail address for Class Notes from my work address to that shown

below. —**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301; e-mail: <rlacey52@aol.com>

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Please send news for this column to: **Joseph M. Cahn**, secretary, 20 Ocean Park Blvd., #9, Santa Monica, CA 90405-3557; tel: (310) 396-6322, fax: (310) 553-0687;

e-mail: <jmc20@aol.com>.

54

A year has passed since our 40th Reunion, and news about members of the class has dwindled. Let me hear from you—a short note would be fine. The only item this

time is a brief word from **Bob Reichard** informing us that **Dick Finn** has been easing into retirement from Digital Equipment Corp. by searching the west coast of Florida for a place to settle. What are you doing these days?—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

55

Dennis Shapiro reports that he and his wife, Susan, went skiing in Alta, Utah, in late March. They had a fine week—great snow and sun and no broken bones. While there,

Denny checked in on **Thomas Stockham** in Salt Lake City. Tom has been diagnosed with Alzheimer's and has retired from the faculty of the Department of Electrical Engineering at the University of Utah. Denny was able to be at a testimonial for Tom held on April 1 that was attended by friends from across the country. After graduation, Tom went on to receive SM and ScD degrees in electrical engineering from the Institute, was an instructor, receiving the Goodwin Teaching Award, and an assistant professor before joining the staff at Lincoln Laboratory. In 1968 he was appointed to the computer science faculty at the University of Utah where his work in image deblurring and sound dereverberation led to the widely acclaimed publicized restoration of the entire collection of recordings by Enrico Caruso for RCA in the last 1970s. In 1973–74 Tom served on the panel of experts assembled by Judge John Sirica to examine the Watergate tapes. In 1975, he founded Soundstream, Inc., which pioneered the development of equipment and methods for digital commercial sound recording and editing. In 1980, Soundstream merged with Digital Recording Corp., where Tom applied his technology to the development of an optical digital sound recording system, an effort in competition with the Sony/Phillips development of the digital compact disc. In 1983, Tom rejoined the faculty at the University of Utah. His numerous awards include a number for teaching excellence, an Emmy in 1988, and a Grammy in 1993 for digital sound recording activities. Tom is doing fine and is hopeful that the Alzheimer's will stabilize and that advances in medical science will come along to help.

We regret to report the death of the Reverend **Paul M. Quay** in Chicago on October 10, 1994. Paul was a Jesuit priest and research professor of philosophy at Loyola University in Chicago, where he taught physics, spiritual-

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ity, philosophy, and ethical aspects of abortion. Paul earned a PhD from MIT and from 1967 to 1981 was an associate professor of physics at St. Louis University. He became a research professor at Loyola in 1981. He published articles on cadavers, spirituality, moral theology, physics, and philosophy of science. There are no immediate survivors.

By the time you read this, Co-secretary **Roy Salzman** will have retired to Rockport, Maine. Roy and Doris have long enjoyed it there and have been looking forward to this for some time. Roy had been in the Washington office of Arthur D. Little for the last couple of years. Doris and the family dogs relocated to Rockport a few months ago, leaving Roy to apartment living and commuting on weekends when possible. In May, Roy was inducted into the Arthur D. Little 25-year Club, and he and Doris enjoyed her 60th birthday at a celebration at their daughter's on Cape Cod.—Co-secretaries: **Roy M. Salzman**, P.O. Box 197, Rockport, Maine 04856-0197; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042

56 40th Reunion

Peter Alexander has been in Colorado for several years. He has been managing work at major Department of Energy sites relating to nuclear waste disposal and cleaning up the weapons complex. Peter has three grandchildren. . . . **John Mulholland** of Chatham, N.J., writes that he is a structural consultant for a series of plants that will turn sludge and food waste into compost. John and his wife have three children and two grandchildren. . . . **Rosalie and Craig Sherbrooke** have moved to Camarillo, Calif., where he is semi-retired. John Wiley & Sons published his book, *Optimal Inventory Modeling of Systems* about a year ago and he is still teaching short courses. Their son, Evan, '90 (XVIII), completed a PhD at MIT in ocean engineering in April. Evan organized, coached, and played on the MIT Club Volleyball team and led them to the New England championship. Send news to **Ralph A. Kohl**, co-secretary, 54 Bound Brook Rd., Newton, MA 02161; e-mail: <kohl@ll.mit.edu>.

57 Please send news for this column to:
John Christian, secretary
7 Union Wharf
Boston, MA 02109

58 A letter from Institute Provost Mark S. Wrighton to Class President **Mike Brose** dated April 24, 1995, announces that, "Professor Bernd Widdig has been selected to be the next holder of the Class of 1958 Career Development Professorship. Professor Widdig was selected in recognition of his outstanding contributions in education and research, particularly his innovative and imaginative teaching. He received the Erstes Staatsexamen (the equivalent of a bachelor's and master's) in political science, sociology, and German litera-



Ted Kraver, '60—artist, engineer, community activist, computer guru, educator, student, businessman, model airplane builder, lobbyist, philosopher, and devoted family man.

ture from the University of Bonn, Germany, in 1983 and a PhD in German Studies from Stanford University in 1989. He was appointed assistant professor of German Studies here at MIT in 1992. Prior to this appointment, Professor Widdig was a visiting professor here. He is the author of numerous journal articles and reviews and has received several prestigious fellowship grants and honors."

The letter continues: "For a young, non-tenured member of the faculty, appointment to a career development chair provides much needed encouragement, freedom, and visibility at a critical time in his or her academic career, when creative and intellectual powers are near their peak and professional pressures are greatest. Thank you, on behalf of your class, for the generous gifts of the members of the Class of 1958 that have provided us the resources to recognize the accomplishments of young professors like Professor Widdig. As you head into your 40th Reunion celebration, I also hope you and your classmates will have the opportunity to get to know Professor Widdig and some of the wonderful work he is doing." Professor Widdig, wir gratulieren Ihnen!

While cycling along the Minuteman Bikeway last spring, I overtook fellow Lexingtonian and Course X alum **Bob Hausslein** out for a stroll with his son Tom. Hadn't seen him in a while since I missed our most recent annual hike weekend with a group of other "Course Tenners" and friends in the White Mountains (where he usually sets the pace and I struggle along behind!) After staying on for an ScD in chemical engineering, our careers converged during our tenure at Amicon in the mid-60s. Then Bob joined Polaroid and after 16 years there moved to his present position at Hyperion, a high-tech startup involved in commercializing novel carbon nanofibers. Bob and wife Evelyn enjoy spending time in Vermont

with older son Robert, a builder, and their two grandchildren. Their daughter, Evelyn, followed in her mother's footsteps and graduated from Wellesley College this past spring, although Bob is quick to point out that she took courses at MIT as well!

Robert Crice sends word that he is "retired now for over five years and I recommend it. Occasional work for a local engineering company, church, fly fishing, art, family, and volunteer work are enough to keep me active and well. Kentucky is a great place to retire for those who want to get out of the fast lane." . . . **Walter Braun** is self-employed and working on a book about Lidar remote sensing of the atmosphere. . . . For a change of pace, consider what keeps **Carl Hellsten** busy: "Still very active racing professional outboard hydroplanes. Finished in the top 10 in both the '94 World Championships in Nottingham, England, and European Championships in Milan, Italy. Also very active as consultant to FAA in the area of aircraft icing." What variety! Now it's your turn. Send your info to—**Gary Fallick**, secretary, 4 Diehl Rd., Lexington, MA 02173

59 A report on the Class of '59's 35th Reunion Gift project stems from a recent lunch meeting with **Chuck Staples**, **Mike Drew**, **Art Colias**, **Dick Sampson**, and myself where we unveiled the finished print of an original painting by well-known artist **Ray Ellis** (who had been one of Mike's orthopedic patients), of the Great Dome, from across the Charles. It's a handsome and impressive work, and prints will be in the hands of major donors from our class to MIT. Makes one want to give!

A recent call from **Bob Muh** informed me

that **Al Oppenheim** will soon be recognized with an honorary doctorate from the Tel Aviv University. Congratulations, Al! And a computererve note from Bob says "Our class had only nine or ten women. Next year's entering class will be close to 40 percent female. It's a very different place today. Our daughter, Carrie, is now a junior and was just elected president of MIT's Undergraduate Association." Thanks, Bob.

Sadly, the press releases from MIT notify us of the deaths of two of our classmates. **William Glenn** died in Vernon, Conn.; he had an impressive career with United Technologies, retiring as senior consulting scientist in 1994. . . . **John Rainey** passed away in Leominster, Mass., in March 1995. After MIT, he received a master's from the University of Tulsa and a doctorate from Rennselaer, and was a computer consultant to M.S. Enterprises in Leominster.

Classmate **Al Bufferd** recently had successful heart bypass surgery and is reported to be recovering well. Our wishes are with you.

That's all for now. Again I urge you to *actually do it*—to send an update, which will be most appreciated by your classmates.—**Dave Packer**, secretary, 31 The Great Rd., Bedford, MA 01730; tel: (617)-275-4056; e-mail: <70421.1766@compuserve.com>

to the MIT faculty in 1993. Professor Scott recently won a national award from the Association of Collegiate Schools for his innovative teaching. It certainly appears that Andrew Scott exemplifies the traits our class has hoped to foster when we established our Endowment for Innovation in Education. We all bid a warm welcome to Professor Scott and wish him well in continuing the Class of '60 spirit for educational innovation.

I just finished a phone conversation with **Addison Ball**, who is still with the National Security Agency and currently working in England, although he said that he will be returning to the United States and Maryland in August. Unfortunately, Addison will not be able to make our reunion.

Chuck Haspel writes from New York City that he has just retired for the second time: first from IBM in 1987, and most recently from Morgan Stanley. Chuck wonders if there are any *three-time* retirees among us.

In a short note, **Bruce Silberg** writes that he is still having problems with the rights to the intellectual property he had created. He has found it hard to protect it after the fact. Good luck in your quest, Bruce.

The April 1995 issue of *The Business Journal* of Phoenix, Ariz., has a very informative and complimentary article on **Ted Kraver**—who, for reasons that will become evident, they find hard to describe. They note that his friends describe him as "quirky," "an egghead," "a bulldog," and "an entrepreneur's entrepreneur." The article describes Ted as an artist, engineer, community activist, computer guru, educator, student, businessman, model airplane builder, lobbyist, philosopher, and a devoted family man. Ted is the president of six organizations, chair of another, and a PhD student at Arizona State University. Ted is also in business with one of his five children, and works a number of community and business groups. An earlier firm he was involved with, Cryocare, froze people who had died and who wanted to be revived should technology be developed that could reverse the cause of death. Ted also founded the Burn Treatment Skin Bank, which bought pigskins from Jimmy Dean Sausage Co., reprocessed them and sold the end-product to hospitals. Also among Ted's developments was a flat-belt, variable-speed engine drive. To market this product, Ted founded Krumm Industries, which had partnerships with General Motors and other firms. There is more in the article about Ted, whose hero is Larry Walters, the California man who flew his lawn chair to 16,000 feet by tying helium balloons to it. Charge on, Ted, and good luck on the dissertation!

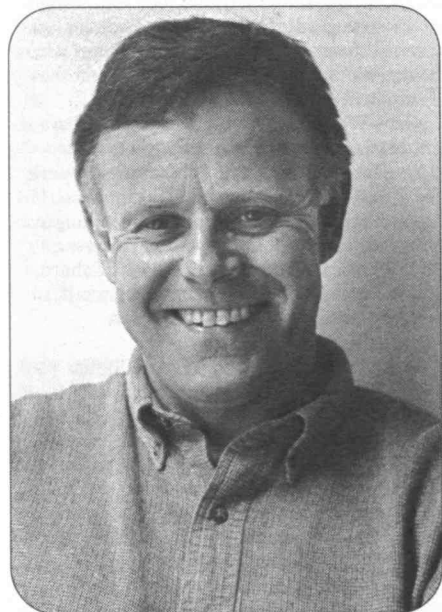
Finally, it is with sadness that I report the death of **Arnold Bersofsky** on January 17, 1995. Arnold lived in Potomac, Md., and is survived by his wife, Deborah, and three children.—**Frank Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

60

Although you will be reading this after reunion time, there is no news of our get-together, as I am writing this in early May.

The lead-off item in this month's news comes from

MIT Provost Mark Wrighton's letter to our class president, **Jorge Rodriguez**. In his letter, Wrighton informed Jorge that Professor Andrew Scott, associate professor of architecture, has been named the next Class of 1960 Fellow. Professor Scott received an architecture degree from the University of Manchester in England in 1976. He worked as a professional architect and teacher in England and Nova Scotia from 1976 until being appointed



PROFESSOR ANDREW SCOTT
CLASS OF 1960 FELLOW

61 35th Reunion

Jerry Milgram was elected to the National Academy of Engineering earlier this year. He is the Koch Professor of Marine Technology at MIT and has devoted his time to designing sailboats

ClassNotes

and sails (some America's Cup hopefuls carry his designs) and various environmental problems such as cleaning up oil spills. There are only about 1,700 members of the NAE so it's a great achievement. Congratulations, Jerry! . . .

I got a short note from **Richard Howe**. It was all about his daughter Kathy, '93 (VII). She teaches biology in Kingston, Jamaica, as a Jesuit volunteer. Quite a switch from molecular biology. . . . Our class set up several scholarship funds back in 1986. Every year we hear about the recipients. They are always an interesting group. The Clarke Swannack Award for '94-'95 went to Ilya Entin, a senior studying physics. She grew up in Moscow but now seems to be thoroughly American. When not working on atomic physics or tutoring she is on the slopes with the Institute's Varsity Ski Team! The AEPi Scholarship went to two undergraduates: Dan Fossner and Eitan Sabo. Both study the dismal science: Economics.

In a fit of anger I quit my job at Harvard in late April. Very strong disagreements with the administration. As I write, in early May, I'm back looking for work. Remarkably, there have been three strong nibbles so far and I may be a taxpayer by next month! In any event my old Harvard e-mail address is defunct. The America Online address, below, works just fine. Please use it early and often.—**Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167; fax: (617) 734-5230; e-mail: <andrewb820@aol.com>

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Art Funkhouser <afunkhouser@clients.switch.ch> contacted us from Switzerland. Until 1993, Art was still working half-time as a physicist in eye research, but now he is doing

therapy and leading dream groups full-time. He also leads a seminar in dream interpretation at the C.G. Jung Institute in Kusnacht (down the lake from Zurich). He gives occasional lectures (in his version of Swiss German and in English) on dream work and the growing dream group movement in Switzerland. Art's 17-year-old son, David, now lives with him, and is educating his father on the finer points of techno-music. They will be returning to Bern in June to a new apartment just below the botanical gardens near the Aare River, which flows around Bern. Art extends an invitation to visitors (if prearranged) at their new apartment. Contact him at: Altenbergstrasse 126, 3013 Bern; tel/fax: 011-4131-331-6600. Art grew up near Oklahoma City, and has been following the events there via CNN on the local cable network. He and his 11-year-old daughter, Jeannine, are traveling to New York City for a conference on dreams, June 20-24, at the Sheraton. He will be giving a lecture and leading a dream group at that conference. They will be staying with Art's youngest sister who manages a restaurant, The Cupping Room, at Broadway and Broom in Soho. After the conference, he and Jeannine will go to Chattanooga, to visit with Art's other sister. If you can't reach Art at his regular Internet address, he may also be contacted via Com-

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D.G. Larson, PhD '92
W.F. Lenz, NUE '77
C.A. Lindberg, '78
A.J. Ricciardelli, '78
M. Walbaum, SM '88

puserve: <100602.260@compuserve.com>.

Jerry Winston contacted us from Australia. He has been keeping in touch with his U.S.-based colleagues via the Internet and welcomes contacts via e-mail. Jerry is teaching public sector evaluation and observes that there are a lot of glazed eyes when he presents stochastic models, systems theory, literature, and philosophy. He can tell that his listeners missed the chance to learn science while studying Professor N. Holland's Introduction to History and Philosophy at MIT. Jerry is currently chair of the committee organizing the Australasian Evaluation Society delegation to the First International Evaluation Conference in Vancouver, BC, in November 1995. After the conference, Jerry plans to visit people and organizations in North America and possibly Europe who are actively involved in some aspect—teaching, practicing, training, theorizing—of public sector programs. He is particularly interested in meeting professionals who are exploring the application of methods that are less familiar in the field of program evaluation—the application of operations research, systems theory, soft systems, fuzzy numbers, and fuzzy sets to the evaluation of public sector and/or human service programs—preferably all of these things together rather than individual applications. His own areas of interest include performance measurement and analysis in government, using quantitative methods in tandem, problem formulation in program evaluation, and the use of distance education to enhance evaluation practice. Jerry would like suggestions of where and whom to visit in Canada, the United States, and Europe. If you know of people who like to mix multidisciplinary qualitative and quantitative methods as applied to public sector evaluation, please contact Jerry by post: Jerome Winston, director, Program for Public Sector Evaluation, Faculty of Applied Science, RMIT, P.O. Box 71, Bundoora, Victoria 3083 Australia. RMIT is the Royal Melbourne Institute of Technology, Melbourne, Australia. He may also be reached via fax: 011-613-467-8708 or via e-mail: <jwinston@arcadia.cs.rmit.edu.au>.

David R. Spencer <drspncr@aol.com> dropped us an e-mail message (from Boston) on his way to Europe where, in addition to seeing his son, Scott, '94 (XIV), who is spending a year at the London School of Economics, he plans to visit with our classmate, **Jonathan Gestetner**, and his family in London. Dave's other son, Marc, is just starting to use his shiny new University of Rochester BSEE at Eastman Kodak, working on cross-platform color management. Dave ran into **Marty Klein** during a recent computer show on electronic publishing in Boston, and reports that Marty is about to be installed as president of the U.S. Bonsai Society. (I think we got the other side of this encounter from Marty in the last column!!) Dave is still enjoying the consultant's life—with emphasis on color printing, with some product evaluation publishing—and a couple of corporate directorships on the side.

... **Juan Calvo** <jcalvo1142@aol.com> contacted us via e-mail from Venezuela (I just love that Internet). Juan has been elected first VP of the Venezuelan Industrial Council, Conindustria, a consortium of the manufacturers associations from all parts of Venezuela. His new address is: Quinta Kariakito, Calle B-2, Urbanización La Lagunita, Caracas, Venezuela.

All communications for this column arrived

through MIT1962 via the Internet. It is a great pleasure to note that we were the pioneers for the new alumni/ae e-mail systems being implemented by the MIT Alumni/ae Office. All classes are now being offered the opportunity to put e-mail systems into place through MITVMA—the same system we have been using for the past few years. MIT Clubs and other alumni/ae organizations will also have the ability to establish e-mail systems, and at least one class has started a World Wide Web home page. We may also use the Web if enough members of our class have appropriate multimedia systems—sound cards, graphics capabilities, and monitors—to handle the offerings of the WWW. If any of you would like to work up a WWW home page for our class, please get in touch with me. Even if you are not living in or visiting the far reaches of the known world, find a window to the Internet and please telecommunicate with: <mit1962@mitvma.mit.edu>. Alternatively, you can send a message directly to me at: <uabhn01@ascube.asc.edu>. If you still communicate by surface mail, please send your Class Notes and personal news to: **Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352.

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Please send news for this column to: **Shoel M. Cohen**, secretary, Dept. of Psychology, Nassau Community College, Garden City, NY 11530; tel: (516) 489-6465 (h); e-mail: <71271.2627@compuserve.com>.

64

Some people move the world—**Dick Posner** (VI) reports that recently the world moved him. Dick lives in Woodland Hills, Calif., about three miles from the epicenter of the last earthquake. Fortunately he had only minor property damage. Dick is currently running the engineering department at Wittaker Electronic Systems. Previously he worked for Hughes and then a small entrepreneurial venture. His son Andy is in the sixth grade. Dick and wife Ludmila just returned from a spring vacation in Tahiti where he reports that the scenery was great, but the mosquitoes formidable.

Gary Walpert's (VI) oldest daughter Tara is graduating from Harvard this June with a degree in economics. She is planning to work for a Boston management consulting firm. His second daughter is a freshman at Washington University in San Francisco. Gary is now a patent attorney and partner at Fish-Richardson in Boston. He will be delivering a talk to the ABA entitled "Current Topics in Inequitable Conduct."

Don't forget to use our new mailbox! (But I will gratefully accept news from any communication medium.)—**Bill Ribich**, secretary, 18 Revere St., Lexington, MA 02173; tel: (617) 862-3617, fax: (617) 890-4084; listserv: <mit1964@mitvma.mit.edu>

65

Michael White writes from Los Angeles that his private law practice is increasingly focused on product liability (defense) and insurance fraud. He was full-time faculty at

USC's School of Public Administration from '75-'87 and still teaches part-time. His wife, Nancy, is also a practicing attorney. For recreation, he's taken up ice skating again on a regular basis—the first time since intramurals for NRSA at MIT (the difference is, he can now afford skates that fit). He's planning to create his own triathlon—cycling, ice skating, and swimming. . . . **John Roach** continues to be chairman and CEO at Fibreboard. He spends his time between San Francisco (home for himself and his two grown daughters); Beaver Creek, Colo., where he has a vacation home for skiing, snowshoeing, golf, biking, and hiking; and Texas, where his stepchildren and grandchildren live. . . . **George Moyer** writes he won't make the 30th Reunion due to son Dan's high school graduation. Daughter Anne is at Wellesley and will be spending junior year abroad at Oxford. George continues to be with Citicorp in L.A., now as a senior analyst for California corporate banking customers. . . . **John Torres** writes that he is technical director for ocean, radar, and sensor systems for the new Lockheed-Martin Corp., located in Syracuse/Utica. Children are out of college and he and wife Patty are beginning to appreciate the life of the childless (and college tuitionless).

Speaking of college, **Ron Newbower** and wife Donna shared the good and bad news as their second son headed off to Duke (their first is at Princeton), leaving them with full tuition bills and limited discretionary income. . . . **Ray Fisher** writes that he has been at General Atomics since 1971 focused on fusion energy research. He suspects his area of focus is not high on the Congressional agenda and hopes to be able to continue. Recently his team obtained the first measurements of the energy distribution of the fusion-generated fast alpha particles in a reacting plasma. Wife Sally recently had an article published in *Cricknet* (children's magazine) and daughter Amy worked for the Council of Economic Advisors during her junior year at Stanford (he reports that she was so concerned about ethics that she told dad not to tell her anything about fusion in case it came up in her work!). Son Brian is a high school sophomore headed, he hopes, to MIT for college. Younger son, Matt, is in sixth grade and just thinking about college. . . . I saw **Peter Klock** at the dedication of the Sustaining Fellows plaque on May 5. **Greg Schaffer** was also there, but we didn't get together. Two more e-mail messages this month. Sounds like we old folks are finally getting into the modern world!—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167; tel: (617) 232-4710; e-mail: <georgemck@aol.com>

66 30th Reunion

No mail, either electronic or paper this month, but I did manage to chat with a few classmates on a recent trip to Cambridge. **Judy Risinger Perrolle** is currently on sabbatical from Northeastern trying to finish a book (writing not reading). She just completed a visiting term at the Harvard School of Public Health in occupational health and safety. Her daughter, Jeanette Offenbacher, is an architect in Washington, D.C., and has just presented

Judy and Pierre, '65, with their first grandchild, Peter.

Robert Akeson is a teacher of science and biology at Boston Latin High School where he has been since graduation. There aren't many in our class who have stayed in one place that long. He is married and has three children. . . . **Howard Van Vleck, Jr.**, is another longtime Boston-area resident. Although he and his wife went to Chile in the Peace Corps right after graduation, they returned to Cambridge in 1970. After working for a large architectural firm, Howard went off on his own and has been self-employed as an architect for nearly 20 years. He and his wife have two daughters, one at Haverford College in Philadelphia and one in high school. He spends his spare time sailing off the Cape and doing carpentry.

Samuel Galpin is a software engineer for Foxboro Systems, building process control systems. He is married and the father of three boys, one of whom teaches at an Indian reservation in Washington state.—**Eleanor Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226-4056; e-mail: <vismit66@ubvms.cc.buffalo.edu>

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Please take a few minutes to let me know what's happening in your life. It has been a mere 28 years since we graduated. Noticing that the cupboard was pretty bare in a recent

issue of *Technology Review*, **Jeff Schoenwald** decided to send an e-mail, "even though," he says, "I haven't got a lot of neat and exciting new things to write about." He continues, "As some people in the industrial research and development field must already know, a good many corporate R&D labs have been shut down, disbanded, or dispersed to operating divisions. The Rockwell Science Center, so far, has resisted a breakup by pushing very hard into development of technologies and even product prototypes for our commercial divisions. Every project is reviewed for direct impact on the company's business interests. Project funding is usually less lavish than in days of old, and the divisions are demanding results with a warranty. It is both very exciting and often frustrating and scary. Institutional corporate research labs must fight to cut overhead costs to keep the development (and, therefore, return on investment) in line with the manufacturing division's goals and objectives in a global slugfest. Modern commercial R&D may be taking on an image that looks less like white coats and horn-rimmed glasses and more like mud wrestling." Jeff continues, "On a personal note, 1994 was a difficult year: In March, my daughter, Elyse, suffered a near fatal twisting and blockage of her small intestine and the blood vessels that supply it. It was apparently the culminating phase of a defect she was born with. The surgeons ordered emergency surgery (at 1:30 a.m., naturally) and unraveled her innards to unblock the blood supply and digestive tract. Waiting another two hours would have been fatal. However, she has had a complete recovery, and today she is a very healthy and thriving 12-year-old. Her spirit is indomitable, and every day I am thankful she slipped through a fast closing door back into the sunlight." Don't family and children make it all worthwhile!

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Kevin Kinsella has been named permanent CEO of Sequana Therapeutics, a privately held genomics company in La Jolla, Calif. Previously he was acting CEO. Kevin notes, "One doesn't often have the opportunity to contribute to the creation of a new industry, much less one like genomics that will revolutionize medical diagnosis, treatment, and drug discovery." Sequana Therapeutics was founded in 1993 to discover the genes involved in major diseases and to participate in the development of new diagnostic and therapeutic products based on these discoveries. Kevin is managing general partner of Avalon Ventures, a private venture capital limited partnership he founded in 1983. Avalon successfully helped found and invested in over 30 companies. He has served or is serving as a director of several companies.

I enjoyed reading e-mail from Adam Powell III, whom I last met at our 25th Reunion, which was also graduation day for his older son, Adam (Course III). Last June he returned for the graduation of his younger son, Sherman (Course XV). Sherman has decided to enter the armed services. By the way, I was sent the e-mail and WWW home page addresses for both sons, with the warning that some of his younger son's home page data may be intended more for amusement than accuracy. His older son has continued at MIT and has finished his third year of PhD work.

After 10 years as a consultant, Adam has joined the Freedom Forum Media Studies Center at Columbia University, as its director of Technology Studies and Programs. He believes this is the perfect time to be looking at technology and media. In his new position, Adam directs all of the Center's conferences, seminars, and programs worldwide on journalism, communications policy, and media companies and their policies and practices. This includes coordination of research and investigations of new media and new information technologies, and presenting current information to audiences that include journalists, managers, educators, policy makers and researchers. Rather than trying to instruct participants on a particular piece of hardware or software, they try to introduce the notion of change as a metaphor (how to think versus what to think), because the only constant is continuous if not accelerating change. Sounds familiar, doesn't it? They try to send a powerful message of humility. Adam closes each opening session with words Tom Stoppard wrote for a mathematician in his new play, *Arcadia*, who says, "This is a wonderful time to be alive, when everything you know is wrong!"

Adam divides his time between New York City and Arlington, Va., the location of the foundation's headquarters and also the Powell's new home. Adam's wife, a lawyer in

appellate work at the Justice Department, is based in Washington but has arguments in almost every city where federal appellate courts sit.—Charlotte and Jim Swanson, co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024; e-mail: <jswanson@lat.com>

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Not much news in volume this month as spring descends on the banks of the Potomac and the cherry blossoms have just faded while the dogwoods are in their full glory. John Dehne is now president of Loral Infrared and Imaging Systems in Lexington, Mass. . . . Shirley Jackson has been confirmed as chair of the Nuclear Regulatory Commission but as of this writing has not assumed



25TH REUNION MARSHALLS KAREN ARENSON AND JOSEPH BISACCIO ON COMMENCEMENT DAY

the office. Welcome to Washington.

As you can see the larder is bare so send some news now!—Gail and Mike Marcus, secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818; e-mail: <ghm@nrc.gov> and <mmarcus@fcc.gov>

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I'll try to compensate for the recent absence of notes by giving you an extra dose this time. I plead guilty: I was involved with "infinite work," founding a new magazine, *Infinite Energy—Cold Fusion and New Energy Technology*. Now that it is running as smoothly as a start-up can, I will try to be true to my past record of reasonably regular notes. Speaking of new energy (certainly not in our

aging muscles!), we hear from Stephen T. Lee whose San Jose, Calif., letterhead reads, "Electric Power Consulting, Inc." He reports that since leaving MIT he has been in the consulting business for "electric utility resource planning and the economic evaluation of electric energy technologies."

It's always nice to receive e-mail from one of you. This came from Kendall C. Marr, MD: "I just started using e-mail two months ago to communicate with my son Jonathan who is a freshman at Yale. As you mentioned in the January 1995 *Technology Review*, I am now 'fully electronic.' I was unable to attend the 25th Reunion, but I did visit Cambridge four months later when my wife, Lianne (Simmons '69), and I attended parents' weekend in New Haven. We even visited ZBT in Brookline and were given a tour. It seemed strange returning to visit colleges as a parent instead of as a student.

"MIT was first class in admission procedures for the class of '98.

Jonathan was accepted but did not follow in the family tradition of his grandfather Gilber, '46, uncle Clifford, '70, and father. As noted in my biographical form, I completed my MD at Johns Hopkins, did my medical internship and residency in Cleveland, moved to Bethesda for a two-year military and NIH assignment, and have been in Los Angeles since 1977 for my cardiology fellowship and private practice." . . . Marr also reported that daughter Cara Amy visited MIT in March 1995 to prepare for Class of '00 admission.

A speedy note from Dean Lycas of Poway, Calif., features a sports car logo: "The subsidiary that Alcoa started in electronic packaging is finally starting to have some market presence. With 950 people on site, it's busy. I contrive to participate in the Porsche club track events. It's nice to be able to drive year-round. The Northeast does have a lot more tracks to drive." . . . Matthew Franchiewicz writes: "The manuscript for my book, *Winning at the NLRB*, is complete and is being edited by the publisher. It is a compilation of practical advice of attorneys,

union representatives, human resources managers, and others who deal with the National Labor Relations Board. Over 1,300 pages of manuscript, 1,800-plus footnotes, and hardly any equations. Publication is expected in the fall of 1995. Meanwhile, in 1995 I expect to stop practicing law and do arbitration exclusively (mostly labor, some commercial)." . . . Paul D. Epstein writes, "Since I missed our 25th Reunion, I didn't get to tell classmates about the exciting times I had working for Vice-President Gore's National Performance Review from June '93 through January '94." . . . Geoff Russell, already looking forward to our 30th Reunion after just having returned from the 25th says, "Our boys have now set their sights on MIT. Jared even met two room-

mates-to-be in the Progeny Program during the reunion!"

And now for the "Letter of the Month" award. Last February, Ron Beatty wrote from Shawnee Mission, Kans.: "I was part of the incoming Class of '69, but dropped out for a year and graduated with Class of '70 in Course XVIII. I've been a computer programmer and travel addict ever since. I've held 15 different jobs, writing programs in 25 different languages since graduation. I've never held a job longer than four years. I'm now retired for the third time to a 'comfortable level of poverty.' I'm living in Kansas City, waiting for my sweetie, Marsha Schauer, to retire in two years. After her retirement, we'll commence traveling throughout the West.

"I usually travel by motorcycle. My trusty BMW R100RT has taken me more than 150,000 miles, to every corner of the country and into Canada. I camped out, traveled, and visited friends for five years before meeting Marsha on a Sierra Club trail maintenance trip in New Mexico four years ago. I strongly urge everyone to spend time in our National Parks. These are scenic gems that are special treasures in the off seasons when the crowds thin out.

"I'm still a fitness nut. I play basketball and run. I've only gained ten pounds since graduation. Usually I can take excess weight off quickly, but that somehow changed three years ago. My other addictive hobby is genealogy. I've written a genealogy computer program that I'm just starting to market for \$25 a copy. A shareware version is available for a free trial.

"I'm sending along my 'Ice Cream resume,' which Edy's like well enough to select me as their Ice Cream Ambassador for Kansas City for 1995. I'm also sending my description of Burton 3's 25th annual DTYD Patriot's Day party. I've tried to list everyone from the MIT years who attended. David Towner, '92, the present MIT residents, and local alumni/ae Dan Bloom, '72, and Bonnie Kellermann, '72, deserve a heartfelt thanks for putting together a memorable occasion. In fact, the DTYD party was so very enjoyable that Greg Gowdy, '70, and I have decided to attend the 25th Reunion (Class of '70) this year. See you there! David is a very ambitious guy and is collecting stories for a History of Burton 3. Burton 3 residents who want to protect their reputations and places in history better write to him soon."

We learn from the Alumni/ae Association that the very first recipient of the Class of 1969 Paul E. Gray Scholarship has been selected. He is Alula Abera, a junior from Washington, D.C. Alula was born in Addis Ababa, Ethiopia, and is now a citizen of the U.S. Alula is majoring in mechanical engineering and has an outstanding academic record. He serves as treasurer of the National Society of Black Engineers and belongs to the African Students Association. He is also active in his dormitory, where he serves as a dorm representative, and participates in the Solar Car Club. For recreation, Alula enjoys sailing, soccer, and lifting weights. Upon graduation from MIT, he hopes to pursue an MBA degree.

That's all folks. Those of you who are fully electronic can reach me or submit class notes via the Internet.—Eugene F. Mallove, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304; e-mail: <76570.2270@compuserve.com>

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York, NY 10023

There is little news this month, and what there is, is sad—Leroy Pusey died last October.—Greg and Karen Arenson, secretaries, 125 W. 76th St., Apt. 2A, New

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25th Reunion

Leslie Rahl was prominently featured in the May 8 edition of *Forbes* magazine. She has formed a firm, Capital Market Risk Advisors, in New York that specializes in derivatives and risk management. She was formerly with Citibank's derivatives group. They are doing well with more business than they can handle. When Leslie sent a note in several years ago about what she was doing, I couldn't understand it. I think the folks in Orange County, Calif., should have seen Leslie earlier about their investments. . . . Stephen P. Baxter has completed running Asia-Pacific for Data General. He has visited mainland China, Vietnam, Papua, New Guinea, in addition to the more sought after geographic locations.

It is unfortunate to announce the death of two of our classmates. Siegfried Mathias was an engineer with Arthur D. Little, Inc. He is survived by his wife, Glenda who writes: "Sig enjoyed his time at MIT and always spoke fondly of the professors." . . . Robert Allen Deich died in a traffic accident on December 26, 1994. He is survived by his wife, Cheeptip

ClassNotes

Benyajati, PhD. Bob was employed by Praxis Biologics. In his honor, a reflectionary is going to be created by a facility enveloping two sequoia trees that he had planted. His company will also have a memorial lecture with a guest speaker whose scientific interests relate to molecular biology. Because his fellow employees considered his coffee mug to be an extension of his arm, they are going to plant a perennial in his mug. He was a principle scientist with Praxis in molecular biology. In addition to receiving an SB in physics from MIT, he received a PhD from Princeton in biochemical sciences. He was an adjunct scientist with the University of Rochester School of Medicine and had previously been a scientist with the National Cancer Institute and a post-doctoral fellow at the Johns Hopkins University School of Medicine. He had numerous publications and abstracts and four patents. All of us extend our sympathies to the families of Sig and Bob.—R. Hal Moorman, secretary, P.O. Box 1808, Brenham, TX 77834-1808

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Steve Henry felt we could use some news and sent in a lot of great notes, including that he has been busy traveling all over the globe expanding his patent law practice. He has given sem-



Leslie Rahl, '71 (left), and Tanya Beder specialize in derivatives and risk-management. Their year-old New York firm, Capital Market Risk Advisors, has a blue-chip list of clients, including dealers and end-users like banks, insurance companies, municipalities, corporations, and mutual and pension funds. In their first year they've brought in over \$5 million, and they expect to double their staff to 24 within 18 months.

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inars, testified all over the world on intellectual property issues, and worked for clients. He has been interviewed a lot, and quoted in *CIO* magazine and the *Boston Globe*. His "reward for these efforts (or punishment) is to have been named by his partners to be the managing partner of (their) law firm, Wolf, Greenfield & Sacks." In addition, his firstborn, Suzanne, was named a National Merit scholar, capping a great high school career, but she had begun her college studies at Wellesley, only taking an IAP course at MIT. Younger brother and sister, David and Michelle, are now in high school and flourishing; David as an almost an eagle scout and Michelle as a wonderful flutist. Wife Carol is trying to figure out which way to use her teaching and other talents without falling victim to the current problems in higher education.

Steve finally notes that he is proud of us, his classmates, since we contributed \$278,798 to the Alumni/ae Fund in fiscal 1994 (which ended in June 1994). Hopefully we have done even better this year. The 25th Reunion Class of 1969 did better than us by only \$50,000, and apparently we had some even more generous alumni/ae, since he says that our actual number was even higher; however the numbers for individuals are capped at \$100,000 on the report. So keep up the great work everyone, and let's beat the next reunion class on our way to making our own records. Although Steve apologizes for the lack of a personal letter of thanks to each of us who contributed to our great showing, he promises that if we "repeat or beat last year's performance this year, (he) will make sure that everyone who donates does receive a personal note even if (he has) to draft an assistant or co-class agent to do so. (That's a challenge folks!)." So let's make sure that this year he has lots of notes to write!

Douglas Coonley and Suzanne are well and enjoying their sons, Kip and Brett. Kip is a sophomore at Bates, and Brett is a senior in high school. They are finishing work on their passive solar home, and enjoyed the winter snows. . . . Larry Lasky sent a long note. In the past year, he left Minneapolis to become director of Transfusion Medicine and associate professor of Pathology and Internal Medicine at the Ohio State University Medical Center. Susie went to Riverside Methodist Hospital where she is now department chair and laboratory director. Last April, shortly after the move, they had a daughter, Emma Fradelle. Her brother Charlie, at age 4, is already a computer buff. . . . Lewis T. Jester III has been transferred to Atlanta where he is president and CEO of Plantation Pipeline Co. (jointly owned by Chevron, Exxon, and Shell). Suzanne continues to be very active on school and community boards. Larissa at 16 was just accepted to the Harvard-Radcliffe Class of 1999 and 13-year-old Lindsay is heavily into the 3 As of academics, athletics, and arts.

That's all the news for now, send in your news to share.—Co-secretary Wendy Elaine Erb, secretary, 6001 Pelican Bay Blvd., #1001, Naples, FL 33963

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Daryl Boggs is performing wind-loading analysis for tall buildings, for Cermak Peterka Peterson, Inc., and has just finished extensive remodeling of his house with his wife, Helen.

. . . Kevin Trangle is the president of Business Health Management, specializing in manage-

ment consultation for OSHA issues, occupational medicine programs, workers comp, cost control, etc. The Trangles are married ten years, with four boys. . . . Laddie Cook has taken a leave of absence from Arthur D. Little after 20 years, to pursue an MS in finance, and to take care of their four children.

Write or e-mail!—Robert M. O. Sutton, Sr., secretary, "Chapel Hill," 7721 Churchill Ct., Marshall, VA 22115; e-mail: <sutton@smp.pcmail.prc.com>

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Please send news for this column to: Co-secretaries: Dave Withee, 3702 Adams St., Two Rivers, WI 54241-1404; Barry Nelson, 65 Hillsdale Ave., W. Newton, MA 02165-2543; e-mail: <bnelson@smp.cspi.com>

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Here's news from two of our classmates. Richard Barron says, "After graduating, I worked as a programmer for short periods in Washington, Boston, and Germany, before returning to Washington in 1978. I eventually met my wife, Carol, and we wed in 1979. We have three children—Elysa (14), David (12), and Megan (3). In 1981, I started a business with my brother-in-law to sell repair parts to property management companies maintaining apartment buildings. It's like a hardware store. I generated the programs to help run the business. We grew from seven employees to over 100 now. My hobbies include the stock market and running. I intend to become a stock analyst in the next couple of years. I did well in a recent Fidelity challenge and would like to pursue this further. I ran a few marathons around 1980 and one in 1993. I keep in touch with Chris, '74, and Joyce Demain, Howard Finkelstein, and Dennis Fromholzer, and fellow ZBTers.

Kenneth M. Johnson writes: "Since the last reunion, I traded in my neural nets for a social fishing line that has led to both a wife, Betty Zielinski, and a son, Connor MacMurphy Johnson, born April 3, 1993, giving me even more reasons for bleary-eyed mornings from lack-o-sleep, supplementing the traditional [sic] causes: problem sets, partying, red-eye flights.

"I moved out to Olympia, Wash., from that other Washington in 1993, having created Connor the previous summer following a Radiators concert in the high Sierras during the 4th of July weekend. Betty had driven down from Olympia for a two-week vacation. During that year I maintained three households, including the old one in Annandale, Va., and got enough free flights to support three years of weekend cross-country trips, a superb trip to Oz and New Zealand for the IJCAI conference in 1991, and our belated honeymoon to Kauai this past February.

"My only disappointment in the last five years was being passed over in my attempt to get an audition with the Grateful Dead, on their rotating keyboard chair. I guess the suggestion that everyone get networked on stage with Mac displays was ahead of its time; besides, they already have one MIT tool working for them (John Cutler, having replaced Dan Healy as soundman).

"Recently, I finished my second project in

geographic information systems, working for the state of Washington's Department of Natural Resources. I am looking for more GIS work, or I will be forced to start my own consulting firm, and lose even more sleep. Oh well, I guess Connor will be able to start programming in a couple more years and, soon after, support his Dad and Mom in the lifestyle to which they hope to become accustomed. And some day, before he clutches his college degree, we will make it back for a class reunion and the next Red Sox series victory."

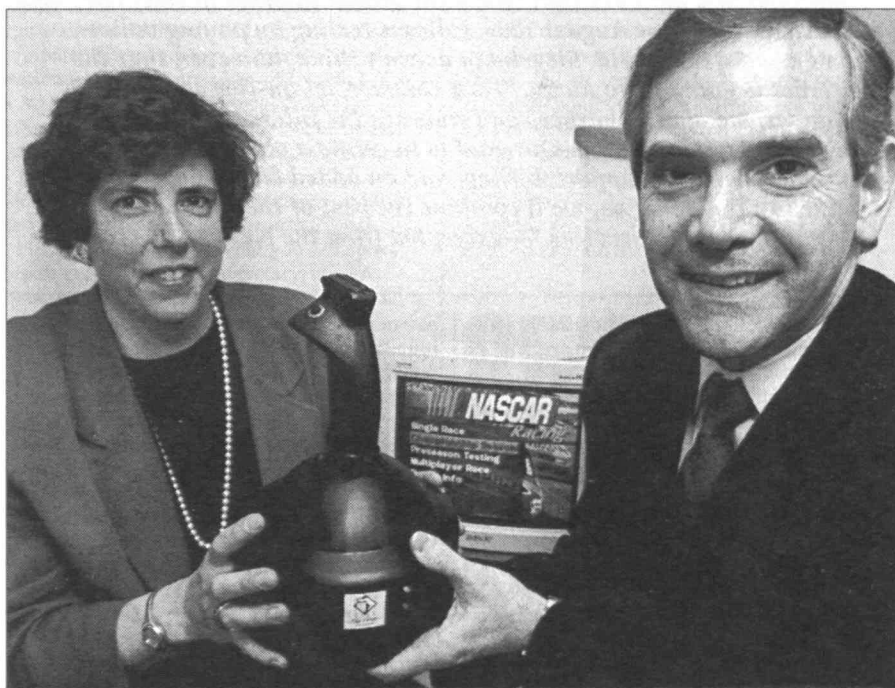
That's all for now.—Jennifer Gordon, secretary, 18 Montgomery Pl., Brooklyn, NY 11215

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Please send news for this column to: **Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523; tel: (516) 295-3632, fax: (516) 295-3230; e-mail: <quantalyt@aol.com>

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Please send news for this column to: **Ninamarie Maragioglio**, secretary 9727 Stipp St. Burke, VA 22015



AND THEY GOT PAID FOR THAT? . . . The company's engineers went out to arcade-game parlors to play games and reasearch the market. "Fundamental research is what I call it," says Beth Marcus, '79, founder, chairwoman, and CTO of the 13-person company, EXOS, in Woburn, Mass. Marcus and Carl Muscan, president and CEO (above), wanted to add "feel" to arcade games (vibrations of a race car skidding around corners . . . the free fall of an airplane diving to earth . . . the kick when a gun is fired), so they developed a motorized game controller for joystick-controlled games. They expect the new product to be on the market early next year.

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Please send news for this column to: **Jim Bidigare**, secretary, 9095 North Street Rd. NW, Newark, OH 43055-9538; tel: (614) 745-2676, fax: (614) 745-5648

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Mark Schuetz started a company manufacturing plastic mirrors in 1991. He is also the father of two children, ages 7 and 11. He would love to hear from his MIT friends. . . . **Lee**

Weinstein is with the Metabolic Diseases Branch of the NIDDK doing research on disorders of G protein signal transduction. . . . We spotted **Ron Newman's** name in the *New York Times* in March when he was quoted about the Congressional proposal to ban pornography on the Internet. Here's the *Times* quote: "Anybody who knows anything technical about the Internet would understand that this is ridiculous," said Ron Newman, a computer programmer in Somerville, Mass., who until recently worked at the Media Lab at the Massachusetts Institute of Technology. "I suspect it will be laughed at collectively by the Internet users of this country and ignored, and as for the rest of the world's Internet community, it will make the United States a laughing-stock."

Beth Marcus's picture showed up in the

ClassNotes

Business Section of the *Boston Globe* in April in an article about entrepreneurs seeking venture capital. The article spoke of Beth's experience in launching her company, EXOS, Inc., which manufactures motorized joysticks for computer games.

Your faithful secretary is having one of those months that try men's souls (and doesn't do anything positive for their sleep patterns either). Right now, I'm packing up my apartment since I'm moving next weekend. The following weekend, I open in a starring role Off-Off-Broadway in *The Musical Comedy Murders of 1940*. The play runs for two weekends, and during the four days the show is dark, I've got to be in Florida for a business trip. If I live through this, I'll be back next month in these pages.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

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By the time you read this, our 15th Reunion will have taken place. I hope everyone who attended had a great time. Unfortunately I was not able to attend. If you were

there send your news—who did you see, what are they up to and don't forget to tell us about yourself! In a few issues you'll find out who our new officers are. So on to the news I do have: **BIRTH ANNOUNCEMENT:** **David Krowitz** and his wife of six years, Sandra Larkin, are experiencing parenthood for the first time with Benjamin L. Krowitz (1). David is working for Molten Metal Technology, an environmental engineering firm specializing in recycling toxic and hazardous wastes. His daily commute was cut from three hours to 40 minutes. "Life can't get much better," David claims. . . . **LAWYERS:** **Stephen McNamara** is still enjoying obtaining and litigating patents in Stamford, Connecticut. He and wife Kathleen were expecting their third child this past April. . . . Also in the patent business is **Gary Engelson**. After being let go from Digital in 1990, Gary began working as a patent agent with the Boston firm of Wolf, Greenfield, & Sachs, PC. He graduated from Suffolk University Law School in May with a JD and plans to continue his career at Wolf in the new capacity of associate. On a sad note Gary writes that he and his wife of 10 years divorced in 1992 and his dad passed away this last June. . . . **OTHER NEWS:** **Andrew Braunstein** is enjoying the new MIT Club in central Florida. They are going behind the scenes touring at Splendid China and deep-sea fishing. Andrew says, "Come on down, the weather is great!" . . . **Gail Randall Holton** writes that she has a fantastic husband and a growing software business. Her company, Desert Sky Software, took a break from building relational databases and put an interactive multimedia kiosk in the Phoenix Suns' basketball arena. Send your news to: **Kim Zaugg**, secretary, 549 Fairfield Rd., Canton, MI 48188; tel: (313) 981-1785; e-mail: <vayda@erim.org>

81 15th Reunion

As I write this issue's column, we are commemorating the 50th anniversary of V-E Day, and as you're reading this column, V-J Day + 50 is being observed. Many of us have parents, relatives or friends who were there to celebrate the end of World War II. Some of them may even have participated in that noble cause. In my own case, my father fought in the Pacific, in New Guinea, and the Philippines. It's worth remembering the sacrifices they made, and the many others who gave their lives for the freedom we still enjoy.

While we're on the subject of commemorations, it's not too early to start planning for our 15th Reunion! It's less than a year away, hard to believe as that may be. So keep a few days in June open for the festivities.

SIMPSON UPDATE: Joseph D'Ambrosio informs us that he is a managing director of The Taylor Simpson Group, a commercial real estate investment firm in the Big Apple. He's living in Bronxville, N.Y., with his wife and four children, ages 6, 5, 3 and 1.

AMAZING: I actually got a call from one of our classmates! And I'm happy to report that Clif Schieck is doing amazingly well up in Santa Clara, where in June '94 he started up a company called CADmazing Solutions, Inc. (you web surfers, check out the info at <<http://www.cadmazing.com/cadmazing>>). The company is doing very well. As for Clif himself, in May '93 he tied the knot with Col-in Bunnell, after which the new duo took off for two months of island hopping in Indonesia and a great honeymoon. Clif and spouse tell us that they enjoy hiking and mountain biking, have two energetic Jack Russell terriers, and are friends with Paul Kostka, who's in nearby Mountain View. Clif can be reached at his own personal e-mail address at <clif@schieck.com>.

NEW PRINCIPAL: Congratulations to Heidi Harvey on her election as a principal and shareholder in the Boston office of the intellectual property law firm Fish & Richardson P.C. Heidi earned a JD from Cornell and practices patent, trademark, and copyright litigation and related counseling. (A wonderful profession—I heartily recommend it.)

SECOND DAUGHTERS: Two of our classmates report second additions to their respective families. Vicki Woolworth had her second daughter, Robin, in August '93. Vicki's now working for DataGenetics, a small DNA analysis company "only 10 minutes from home." Vicki can be reached by e-mail at <72702.3546@compuserve.com>. . . . Thomas Semple tells us that second daughter Alexandra was born in July '94, joining older sister Alana, who's now 2. Thomas was planning a fun summer, including the first two weeks of July on the Cape to visit relatives, and a trip to Chicago in August to visit pals Pete Jernakoff and Kevin Bowie. Back from vacation, Thomas is still doing physical-organic chemistry at Shell Oil, where he's been for seven years and counting.

CONSULTING: Two more of our classmates note that they are consulting in various capacities. Robert Worthington-Kirsch has left his position with MCMC Radiology Associates, and is now working as an independent subcontractor supplying reading services and call



Russ Siegelman, '84, doesn't mind working 12-hour days because he loves his job. When he interviewed with the fabled Bill Gates, chairman of Microsoft, two years ago, Siegelman affirmed his interest in helping to make the Microsoft Network king of the on-line universe. If his game plan is successful, tens of millions of personal computers around the world that now use Microsoft software will be connected to a network that rivals the global Internet in size. The launch, planned for August 1995, follows testing by paying volunteers around the world. Siegelman doesn't think, however, that the Internet is going to go away. "As a commercial on-line service provider, we plan to harness and embrace the Internet in a way people don't envision today. Our goal is to create a managed community, with customer support, billing, and an added level of editorial value. And in doing so, we'll combine the best of the Internet and the best of the on-line services."—excerpted from the New York Times.

coverage at a number of different sites. Robert is also doing independent work constructing World Wide Web sites and consulting on Internet access for private companies. . . . Donald Jones is now serving as an internal consultant on business process re-engineering at LeBlond Makino Machine Tool Co. He's enjoying the challenge of facilitating change and constructing new systems. And as you may recall, Don and wife Ruth are avid soccer players. They recently won their 25+ coed indoor soccer league, and were preparing for their next challenge: coaching and the outdoor season.

And speaking of challenges, it won't be such a challenge to send in your news to this column now that you can do it via the Internet! After years of plodding along the Information Backwoods Dirt Road while many of you were doing double-nickels down the Information Superhighway, yours truly has now gotten with the program.

I have to admit, though, that this was essentially a side-effect of my latest transition. Yes, I've moved again. Not quite as far as the last few moves, though. Just a few blocks away in Century City. My new firm, Jeffer, Mangels, Butler & Marmaro, is a general practice firm that has been developing an intellectual property presence. I'm still doing IP law, primarily

patent prosecution and counseling. The new office is in the Fox Tower, which may be more familiar to you as the "Die Hard" building. Some of its more notable tenants include my favorite former president, Ronald Reagan, and Robert Shapiro, of "O.J." notoriety.

That's it for this month. I'll be looking for your e-mail. And don't forget the Class of '81 Room 10-280 renovation project!—Mike Gerardi, secretary, 3372 Olive St., Huntington Park, CA 90255; tel: (213) 587-2929 (h), (310) 203-8080 (w), fax: (310) 203-0567; e-mail: <mmg@jmbm.com>

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This month we have very little in the way of news. It is up to you to let me know what is happening in your life. Please send me some news! . . .

Michael Dominiak is president of the MIT Club of Washington (D.C.). He recently went on an expedition to Guatemala. While there he went hiking through jungles with armed guides and had an exotic adventure in a cave with rushing water and spectacular stalagmite and stalactite formations. . . . Remember, our 15-year Class Reunion is less than two years away. It is not too early to plan on attending. It is becoming

clearer and clearer to me that as the marketplace continues to undergo dramatic changes and global expansion, the power and career opportunities will lie with those individuals who have a strong network of help and resources available to them. We have the potential of helping each other and being stronger together than any of us could possibly be alone. It occurs to me that we don't develop our capacity to accumulate the power that is available to us as a result of attending MIT. That power will enable us to be more autonomous and competitive in this rapidly changing global marketplace that we all find ourselves in. It is up to us to support MIT and make it happen!—**Helen (Fray) Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008; e-mail <fangroup@aol.com>

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Lyman P. Hurd writes that he is working at Iterated Systems as a senior scientist, supervising a team investigating telecom applications of fractal image compression. . . . **Steven**

A. Janowsky writes that he married Eileen Seligson Janowsky on July 31, 1994. Chalk up another one for intraclass marriages.

Nobody else wrote in this month, so here is a random spin through the class directory. **Claire Jalbert** lives in Tolland, Conn., and works for Rogers Corp. . . . **Thomas Issaevitch** is at University of Illinois/Urbana. . . . **Jeffrey Caplitz** is the manager of marketing plans for Jaguar cars in Mahwah, N.J. . . . **Joel Saks** is at Computer Sciences Corp. in San Diego. . . . **Matthew Russell** is president of Russell & Co., in Andover, Mass. . . . **Thomas Rucker** is an engineering manager at Intel in Santa Clara, Calif. . . . **Thomas Over** is a research assistant at the University of Colorado/Boulder. . . . **Bikash Pandey** is a program manager at Intermediate Technology in Katmandu, Nepal.

Please send a note on what you are up to.—**Jonathan M. Goldstein**, secretary, c/o TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110; fax: (617) 574-6728

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"G'day!" writes **Kathy Takayama**. "I've recently emigrated to Australia to work as a research associate in the School of Microbiology at the University of New South

Wales here in Sydney. After three brutal winters postdocing in Madison, Wisc., I am thoroughly enjoying the weather down here. The beaches are absolutely beautiful, the scuba diving is phenomenal, and I've got parrots and cockatoos flying about in the backyard! The only thing I miss terribly is a true N.Y.-style bagel; the imitations here are awfully reminiscent of Wonder Bread. If any alumni/ae happen to come through Sydney or are planning on visiting for the 2000 Olympics, by all means look me up."

"Hiya!" writes **Tim Huckelbery**. "I'm finally back on the middle East Coast, after ten years in the USAF in Sunnyvale, Calif.; Colorado Springs, Colo.; and Cape Canaveral, Fla. I was with Space Command, flying satellites and launching rockets for them. It was a real blast. Now I've left the military and work for Games Workshop, a British company with

U.S. headquarters in Baltimore. We do a variety of tabletop games using miniatures. I'm the convention support liaison and Net rep, and I'm having a blast again! I go to conventions around the country and do product demonstrations (play games) mostly. It's a tough job, but someone has to do it."

Dennis Sacha and his wife, Denise (Neir-inckx, '87), are proud to announce the birth of their daughter, Julia Marie, on April 8, 1995. Two days prior to this, Dennis visited the embassy of the Czech Republic with the MIT Club of Washington, where he was able to confirm that "Shock-a" is the correct pronunciation of his name. Dennis is now in the Naval Air Systems Command as the EP-3 and ES-3 aircraft avionics officer, developing flight and mission avionics for 21st century aircraft. By the time this column is printed, the Sachas will have hosted an Independence Day blowout at their Virginia Beach beach house with a whole bunch of MITers!

Russ Siegelman has scored an incredible coup with his position at Microsoft as the chief architect of the Microsoft Network. Russ received a great writeup in the *New York Times* (Profile, Sunday, February 25, 1995). Russ' plan: to take on 6 million new network users within a year of introduction this August! "All these personal computers getting connected is going to change the way we use PCs," he philosophizes. In a rapidly growing field including the Internet as well as commercial ventures, "we plan to harness and embrace the Internet in a way people don't envision today. Our goal is to create a managed community with customer support, billing, and an added level of editorial value [that will] combine the best of the Internet and the best of the on-line services." Hey, Russ, how about a fast lane on the info highway just for MIT grads?—**Jonathan Miller**, secretary, 1708 Plaza Ct., Mountain View, CA 94040; tel: (415) 961-2394, fax (415) 813-1130; e-mail: <diamonds@well.com>

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Please send news for this column to: **Bill Messner**, secretary, 5927 Alder St., Pittsburgh, PA 15232; tel: (412) 361-4180; e-mail: <bmessner@cmu.edu>, Class of 1985 listserv: <mit1985@mitvma.mit.edu>

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10th Reunion

Gregory Harrison continues to support NASA/JPL's *Galileo* spacecraft as "we" approach Jupiter Orbit Insertion this December. He's been spending much of his free time training in improv comedy at the Groundlings and performing with the improv group, The Legitimate Freaks. He recently helped **John Rulnick** build a really neat tree fort in John's back yard. John even sleeps there occasionally!

Derek Barkey and his wife, Kelly, are living in Cypress, Calif., where they recently purchased a house. He is manager of the Strength Analysis Technology Department of McDonnell Douglas Aerospace in Long Beach. Kelly is a metallurgist at McDonnell Douglas Aerospace in Huntington Beach. . . . **John Schuette** sends word from Texas that he and

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his wife, Dawn, were preparing for daughter Allie's first birthday (in April). He's spending some of his (minimal) spare time helping to start a new branch of the YMCA in the Houston suburbs.

John Port has reached the end of his internship and will be starting his residency in radiology at Johns Hopkins on July 1. His wife will have finished nursing school by then, so they will be a typical MD/RN couple. . . . **John S. Sapirstein** has finished three years of artificial heart research at Penn State, and will be returning to Chicago this spring to finish a general surgery residency at the University of Chicago.

Stephen Lentz has left northern Virginia after seven years and will be working in Kuala Lumpur, Malaysia, for the next 18 months with Time Telekom, a newly created competitive telecommunications provider, helping them to deploy a nationwide fiber-optic network. He can be reached at <steve.lentz@lsii.com> or <stephen@ttsb.po.my>. . . . **Irina Rakin** has moved back to Boston from the Chicago area and is now working for Biogen in Cambridge. . . . **James Person** and **Suzanne (Dunbar) Person** proudly announce the birth of their daughter, Cleo Madeleine.

Lastly, due to an unfortunate e-mail screw-up with my on-line service provider, a message from a classmate was deleted from my account in mid-April. If you were the person who sent an e-mail message to me around that time, and you haven't seen it printed as of this issue, I would greatly appreciate if you could send it to me once again. On a related subject, I'd love to have just one month where our Class Notes column is longer than the column for the Class of '87. I hope you will help make that possible by dropping me a line before the end of this month—in whatever form you prefer (electronic or analog).—**Bill Hobbib**, secretary, 5 Cappy Cir., W. Newton, MA 02165; e-mail: <billhobbib@aol.com>

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Dave Schultz returned to Boston in late February for Chi Phi's annual banquet. He ended up drinking and playing poker with fellow '87 Chi Phi **Dave Kemper**, who currently lives in the Bay Area, **Bill Irving**, who is finishing up at MIT this year, **Anthony Joseph**, graduating from MIT next year, and **Jeff Murley**, who teaches special needs students. In addition, Dave met up with fellow Course XII alum **John Goodman** and **Joe Cerutti**, '86. John is now living in Boston, and works for a publishing company there. He has a great schedule, as he works only four days per week, and he is anxiously awaiting the beginning of summer so that he can spend some of that free time bicycling. Dave and John are both interesting in hearing the whereabouts of other Course XII '87ers. As for his current status, Dave is looking forward to graduating with a PhD in atmospheric science next June. He is also spending some of his free time training for a flatwater sprint kayak competition this summer, in hopes of competing at the Nationals in Seattle this August.—**Jack Leifer**, secretary, 2908 Roses Run, Aiken, SC 29803; tel: (803) 642-3900 (h), (803) 648-6851 (w), fax: (803) 642-2700; e-mail: <leifer@scarolina.edu> or <MIT1987@mitvma.mit.edu>

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Do you realize that 10 years ago we were getting ready to start our sophomore year at MIT? That was the last summer that I lifeguarded and the last time that I had a really good tan. It was also the year that we were going to get real grades, have VI-A interviews, and pick our own roommates. It was the year we were going to get straight As and have that perfect romance. Well I didn't do either, but it was a great year anyway. I am happy to announce that the class of '88 has begun its baby boom. It's a girl! **Catherine Leigh Schmidt** was born on March 29 at 5:07 p.m., 7 pounds 4 ounces. **Peter Schmidt** and his wife, **Hollie**, are enjoying their new baby. . . . **Nirmala Panicker Thomas** and husband **Anthony** had their second daughter on April 13. **Anju Suzanna** was born at 10:53 p.m. and weighed 8 pounds and 3 ounces. Her two-year-old sister, **Asha**, is always hugging and kissing her. You may remember **Asha** from our five-year reunion. **Anju** looks exactly like **Asha** did. The whole family is reliving those sleepless nights. . . . **Charles Hong** and wife **Sun Choi**, '87, are also expecting. **Charles** will be finishing a PhD in genetics in June from Yale. He will be returning to Yale Medical School in the fall. **Sun Choi** is currently working at Hyperion Software, Inc., as a technical lead. . . . It's a boy! **Clark Golestani** and his wife, **Cheryl**, had a son, **Jared Clark**, on February 21. **Jared** has a 21-month-old sister, **Alexis Hope**. **Clark** left Oracle Corp. a year ago to join Merck & Co., Inc., as the director of information and technology architecture in support of Merck Research Labs worldwide.

John Mailhot and **Ann Herrmann Mailhot**, '89, had a son on January 3. **John Corbett** weighed in at 9½ pounds! The family resides in Somerville, N.J., where John is employed at AT&T. . . . **Mike ("Gator") Gaidis** and wife **Denise** had their second child, **Alexander**, on March 12. All is well with mother and baby—the handsome devil looks just like his dad! Their 3-year-old daughter, **Erin**, is growing quickly, and is mastering the art of manipulating her parents. They all enjoy living in southern California while Mike has a postdoc at Caltech. Mike has recently been in touch with **Matt (Jiffy) Turner** and **Paul (Spud) Parfomak**. **Matt** might be coming out to southern California for his new job, and **Paul** is finishing up at Carnegie-Mellon. Mike has also been in touch with local alums. **Brantley Dettmer**, '87, and **Jon Kramarsky**, '87, are sharing an apartment near UCLA, as **Brantley** works to finish an economics PhD there. **Jon** works at Hughes, on some "incredibly super neat stuff." . . . **Pedro Almeida** completed a three-year tour in Germany in November '93. **Pedro** is still flying OH-58 helicopters and is currently assigned to the National Training Center at Ft. Irwin, Calif., in the Mojave Desert. . . . **Susan Ostrowski** is an engineer at Medical, Inc., a medical product startup company. She enjoys playing bridge at the MIT/Draper Lab bridge club where **Lon Sunshine** and **Andy Singer**, '89, also play.

Scott Kitchen married **Jennifer Doyle** (Georgian Court College, psychology, '93) last New Year's Eve. **Rod Kim** was the best man. **Scott** is working for the U.S. Army at Picatinny Arsenal with **Ray Pohl**, '50. **Ray** and **Scott** were both former MITSFS presidents. **Scott** is working on reutilization of 120mm tank ammunition and designing new long-range

training cartridge. . . . Louis Pepe left his job as a computer graphics programmer back in '90 to pursue an MFA in film production at Temple University in Philadelphia. Over the last few years, Louis has been making short quirky documentaries (on topics such as road-kill and Beatles fanatics), teaching film analysis at Temple and U Penn, and working as associate editor on an upcoming PBS documentary about W.E.B. DuBois. Recently, Louis has begun shooting a documentary for Terry Gilliam, following the behind-the-scenes working of his current feature film, which is being shot on location in Philadelphia.

Chris Saito is currently finishing his first year at Stanford's Graduate School of Business. Although it's been a rainy year, the snow has been great up in Tahoe. Chris will be heading back to Boston this summer to work at the Boston Consulting Group. Chris writes that his first year at B-school has been a great experience and he is looking forward to another year. Antoine Firmenich is one of his classmates. Antoine received a PhD in biochemistry from Paul Berg's laboratory at Stanford. He will spend the summer at a Swiss investment company, surveying investment opportunities in the biotechnology industry. Antoine quickly gained the admiration of his classmates this year with his unrestrained sense of humor which always makes class lively. Chris also writes that Mike Couris is living in Orange County, Calif., and serving as a flight surgeon with the Marines. . . . Mike Fox is working at Solar Turbines in San Diego after finishing an aero PhD at the University of Washington. . . . Ernie Prabhakar has just accepted a management consulting position at the Los Angeles office of the Boston Consulting Group, a company that helps Fortune 500 companies solve important strategy and process problems. Ernie will join as a "consultant-in-training," where over the next couple of years he will acquire skills and experience commensurate to an MBA, while working directly with clients. He will be graduating on June 16, 1995, from the California Institute of

Technology, where he is currently writing a PhD thesis in experimental particle physics, titled: "The Life and Death of Strangely Charmed Particles." While management consulting may seem a strange choice for a particle physicist, he finds it a natural fit. "Consulting not only exercises my analytical abilities, but allows me to utilize my experience gained with various religious and student organizations."—Catherine Suriano Singer, secretary, 131 Main St., Andover, MA 01810; e-mail: <singer@mit.edu>

89

Greetings! Thanks to everyone who wrote this month, especially those who were nudged via the "please write" list. This month's list of people to please send news: Mark Abinante, Laura Carter, Daniel Dismukes, Joe Garrison (by special request!), Mary Maier, and Larissa Rodriguez. What are y'all up to? If anyone knows about any of these people or anyone else, please write in.

Teri Centner was down in Florida for President's Day weekend and hung out with Mike Fincke and Linda and Ken Dinndorf. "They showed me all the fun spots they could in the short time I was there." . . . Diane and David Brancazio are now officially parents! "Our son was born on April 5, weighing 7 pounds, 7 ounces. His name is Nicholas James Brancazio, and he's a beautiful little boy. We're convinced that he looks just like the baby on the Gerber baby food jars. Nicholas, by the way, is a name of Italian/Greek descent that means 'owns his own diner' (we have to take his picture in front of Nick's Beef and Beer House when we get a chance). 'James' is for our close friend, James Worden, who probably doesn't realize his role in our getting married in the first place."

Eric Tang is making the most of the California job-hopping culture, and is now working for Sigma Designs in Fremont. John, '88, and Ann (Herrmann) Mailhot celebrated the

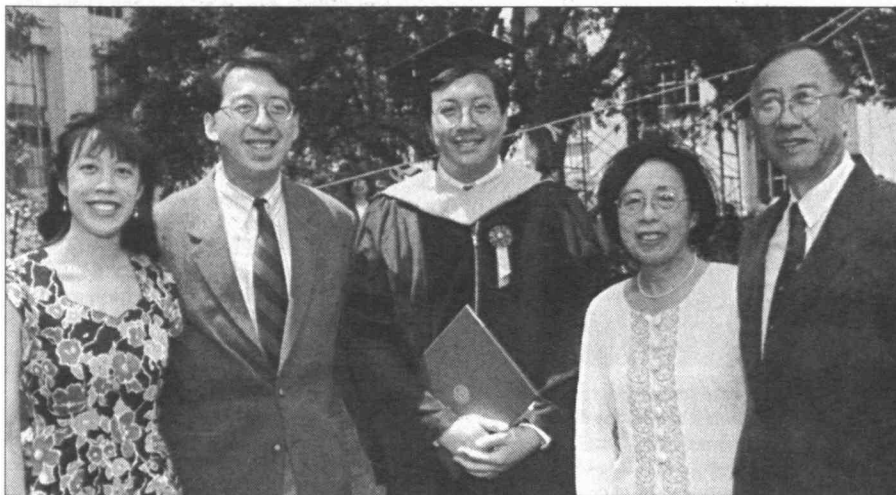
ClassNotes

arrival of John Corbett Mailhot on January 3, 1995! John weighed in at a whopping 91½ pounds, 21 inches. John and Ann are currently living in Somerville, N.J., where John works for AT&T and Ann works at being a full-time mom. . . . Scott Fullam writes to correct a prior error in a Notes column. "It said that I was Class of '90 and was working for Microsoft. I have never worked for Microsoft." Scott, who did VI-A, is currently working for Apple in Santa Clara, Calif. "I am designing the next generation of digital cameras for Apple. I moved out to California in 1992. My roommate is Sue Raisty, '92." (By the way, those VI-As who graduated in '90 but would like to be considered '89 can notify the Alumni/ae Association. You'll then receive the proper reunion notices.) Scott is VP of membership for the MIT Club of Northern California and sees Dave Gessel from time to time. Dave works for Interval Research and lives in San Francisco. Scott's roommate, Adam Kao, is also working out this way for a small startup. Scott's work at Apple has him traveling quite a bit, with Far East trips every six weeks to locales such as China, Hong Kong, and Japan.

Alan Nash writes, "Seeing my name in black and white on the 'please send news' list prompted me to send in an update. The most exciting thing happening now is that I started a small consulting business with a former co-worker from my old job. He and I have had a few small commercial contracts and one large government contract. We started up Practical Imagineering, Inc., last October and managed to hire another programmer a month ago. We do work in scientific analysis and data presentation software, algorithm development, hardware development, and, the old standby, systems engineering. It's a lot of fun, and takes a lot of time and even more luck to be 'successful,' presuming you have a definition of successful to work towards!" Alan is also working on a master's in EE at George Mason University and participating in the usual assortment of activities: volleyball, rollerblading, skiing, and "other creative forms of avoiding cleaning the house." He is living in McLean, Va.

Eric Reifschneider took a new job with Motorola, Inc., on February 1. After two and a-half years of practicing corporate law with a large Chicago law firm, he is now a senior contracts and compliance manager in the Land Mobile Products Sector of Motorola—the part of Motorola that makes two-way radio and paging systems. Eric's responsibilities include managing a group of three people who trains a sales force of hundreds on legal issues arising in transactions with state and local governments. To be closer to work, Eric has moved from downtown Chicago to Schaumburg, Ill., a suburb about 20 minutes west of O'Hare Airport and the home of the world's largest mall. Outside of work, Eric traveled to Taipei, Taiwan, last summer and in October attended a black-tie dinner at which the featured guests were Nelson Mandela and President Clinton. This summer Eric plans to visit a friend in Berlin, Germany.

Jeff Polevoy was married to Sherry Karmel last October 22. The two met in Chicago,



The Family Wang had lots to celebrate when they convened to watch son Mark receive his doctorate in June. From left: Cindy Chi Wen, '89 and SM '89; Frank Yu-Heng, PhD '91; Mark Yu-Da, '87, ScD '94 (September); mother Joyce Chieh-Chun, MCP '61; and father Leon Ru-Liang, ScD '65. As far as we know, the Wangs are the only nuclear family who all hold MIT degrees, and as if that weren't enough, Mark was elected to the MIT Corporation last year.

where both recently earned MBAs (from Prisker and Northwestern, respectively). Following a honeymoon in Hawaii, Jeff and Sherry moved to Omaha, where both work in management. The lavish evening wedding and reception, held on Long Island, were quite a gala, lasting well into the night. The main course was served at midnight, dessert at 1:30 a.m.! Guests included: Shirish Lal, John Mandeville, Cecilia and Andy Norris, Paul Pilotte, Livia Racz, and Heather ('90) and Tim Tibbits. Shirish recently graduated from Harvard Business School, and is now consulting for American Management Systems in the Washington, D.C., area. John and Andy expect to graduate from their respective MD-PhD programs in 1997. John is currently finishing his dissertation in cell biology at Columbia University and enjoys the Manhattan scene. Andy attends Washington University in St. Louis, where he and Cecilia were married in 1992. Paul is an engineer at General Radio and currently lives in Stoneham, Mass. At the wedding, Livia had just returned from a postdoc in Germany, which followed her PhD in material sciences from MIT. She has recently accepted a position at Lasertron in Boston. Thanks to John and Andy for sending this wedding report.

Ignace Kuchazik is working as an actuary for insurance brokers in New York City, up on the 102nd floor of the World Trade Center. "The view is beautiful," Ignace writes. . . . Andrew Chabelal is working on the common berthing mechanism for the International Space Station at the Marshall Space Flight Center in Huntsville, Ala.

That's it again for this month. Please send in news! Photos for next year's calendar (we'll even accept GIF or any electronic file form for photos) would be great as well!—Henry Houh, secretary, 4 Ames St., Cambridge, MA 02142; tel: (617) 225-6680 fax: (617) 253-2673; e-mail: <chh@mit.edu>, World Wide Web: <http://www.tns.lcs.mit.edu/mit89/>

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Congratulations to Jee-Hoon Yap! She will be getting married to Shane Krska on August 12, 1995. Jee-Hoon is expecting to receive a PhD from MIT in June, 1996. Shane is also at MIT. He's working towards a PhD in chemistry. They met at the Park Street Church two years ago and later found out that they were both graduate students at MIT living at Ashdown. . . . Congratulations also to Mary O'Donnell, who was married on March 19, 1995, and Lori Fretz, who will be married in November, 1995. . . . Two more weddings: Kirsten Domingo and Steve Soares, '85, were married on November 12, 1994, in N.H. Quite a number of MIT alums attended their wedding—see picture. Julie Temple and Hal Cohen, '87, were married on September 5, 1993, in Woodbury, N.Y. Once again, a good representative of MIT alums were there to join in the festivities—see picture. Julie and Hal are both living in Brooklyn and putting off the inevitable move to the suburbs.

Peter Gordon is living in Waltham, Mass., and working as a patent agent with Wolf, Greenfield & Sacks, an intellectual property law firm in Boston. Peter will also be graduating from the Suffolk University Law School in May. After graduation, he is planning on working as an associate back at Wolf, Greenfield & Sacks while preparing to take the Mas-



More matrimonial merriment when Kirsten Domingo, '90, married Steve Soares, '85 . . . Standing (l to r): Rick Franklin, '89; Cindy Shen, '90; Mary-Jo Brigante, '89; Hey-Jin Kong, '89 (partially hidden); Stuart Simon, '87; Ellen Case, '90; Mary O'Donnell, '90; the groom and bride; Roy Weatherbee, '86; Steve Beringhouse, '87; Aggie Kim, '88; John Zink, '88; Kelly O'Neill, '88; unknown. Sitting: Mark Wick, '89; unknown; Eileen Murphy, '89; Joe Alfano, '88; and Jane Fisher, '89. Kneeling: Archie Sherman, '91; Erik Domingo, '87; Dave Wu, '85; Chris Monroe, '87; Ryan Fong, '97; and Paul Pilotte, '89.

sachusetts bar exam. . . . Heidi Burgiel is living in Seattle and attending graduate school in math at the University of Washington. Heidi says that while most graduate students teach calculus, she teaches high school teachers to use computers in their classes. Heidi hopes to graduate by fall of 1996 and then move back East. . . . Su Varadarajan is at the Wharton Business School. Thanks to everyone who has made an effort to write in—please keep those notes coming in so we can all keep in touch with each other! Send news to Ning Peng, secretary, 732 Bounty Dr., #3215, Foster City, CA 94404; tel: (415) 578-0704; e-mail: <christine_peng@mail.amsinc.com>

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5th Reunion

Please send news for this column to: Andrew Strehle, secretary, 59 Commonwealth Ave., Apt. 4R, Boston, MA 02116; tel: (617) 450-0637; or by e-mail to Renee (Mong) Miller, <miller-rl@post7.laaf.af.mil>

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Monte Frazier and Jeana Randell were married in June. Congratulations to them! Monte works for Babcock & Wilcox Commonwealth Services Co. . . . Jeff Nielsen is

living in Corvallis, Ore., home of Oregon State University (whose mascot happens to be "the Beavers") and Hewlett Packard, where Jeff works. Jeff is in the ink-jet printer division as is Geoff Mayne who is at their San Diego site. Jeff saw Geoff at a New Year's Eve party this past year at Dan Olster's apartment in Los Angeles. Also in attendance were Eddie Lee, Louis Gonzales, Katie Broughton, Adam Lechner and Ian Sommerville, '93. Jeff says, "We remembered Boston by drinking large quantities of Samuel Adams beer. Hope the 'real world' is treating others as well as it has treated me so far."

Diane Ronan will be starting her second year of graduate studies in the speech and hearing sciences program in the HST division at MIT. . . . Jen Rigney is working for PPG Industries in Pittsburgh. Jen says, "Community college classes and sports keep me busy in my spare time. Spare time—what a novel concept!"

In May I received a notice of my pledge to MIT for this year. I sent in my tax deductible donation and I hope you will all do the same. Please remind all your friends that many of the companies they work for participate in the Matching Gifts Program, so in a sense, any gift they make counts double. Also remember—you won't get *Technology Review* without contributing at least \$25, after we've been out for five years it goes up to \$35. Most importantly, if you do not get *Technology Review*, you won't see my column and keep in touch with your class. So please give some-

thing and please write.—**Leslie A. Barnett**, secretary, 201 E. 83 St., Apt. 2E, New York, NY 10028. Trying to keep up with my address changes? Good luck!

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Hello all! I hope the summer-time has treated you well. I recently completed a trip to Europe, visiting some family in Denmark, then off to Paris, and finishing with a visit to

Elyta Koh, '92, in Rome. Now I am getting ready to settle into first-year classes at Tufts University School of Medicine. I have recieved quite a bit of mail lately so please keep it up! In case you have e-mail please add yourself to the class of '93 list. You can subscribe by sending the command, "subscribe MIT1993" to <listserv@mitvma.mit.edu>.

Shen-yi Sieh survived the Great Hanshin earthquake of January 17, 1995, by ducking out just in time for a business trip to the U.S. She returned to Kobe about a month later to a hotel room and a temporary office. "It was very depressing to see the extent of the damage—familiar places completely changed or missing altogether," she writes. Fortunately, her apartment sustained only minor damage and she plans to return to it soon. Amazingly, the Class of '93 Senior Ball souvenir glass made it through the 20-second disaster intact!

Michelle Caruso has already started her third-year rotations at Columbia Medical School. Michelle became engaged to her boyfriend, Roger Marcincuk, last April. She is also in touch with **Monica Dodds**, who is working for Procter and Gamble in Sacramento, Calif. Monica is loving life on the West Coast and hopes to be transferred to the P&G plant in Southern California.

Arash Salemi is also in New York, attending Cornell Medical School and working hard. Fortunately he still has time to make it to Boston. I caught up with him, **Michael Mini**, **Ken Justin**, and **Ed Wylonis** this past April. Mike Mini has switched gears from mechanical engineering over to civil and transportation engineering. He is working for a company involved in airport design. Ken Justin, in the true entrepreneurial spirit, has started a company based in Malden. Ed lives in Central Square and is attending classes towards a graduate degree at MIT.

While **Avik Roy**, now a third-year medical student at Yale, should have been spending his spring cramming for the boards, he managed to take off for a week or two and travel with **John Smutnick**, who is working for the consulting firm, Charles River Associates, in Boston. In February, Avik was elected to membership in the Elizabethan Club, a Yale literary society, and appeared on C-SPAN in March, where he debated George Stephanopoulos on the merits of the Clin-

ton agenda. He also managed to spend a few weekends yacht racing this summer while also on a pediatrics rotation.

Monthakan Ratnarathorn is a third-year med student at BU with **Suzelle Tardif** and **Amy Ciao**, '92. She is also working in David Baltimore's lab which has now moved back to MIT. M.R. is in touch with **Karen Oda** and **Sue Choe**. Karen is at UCLA Medical School and is taking this year off because she won a Howard Hughes Fellowship. In May, Sue came to Boston to visit M.R. from New York where she is a third year at Einstein.

Also at BU School of Medicine, in his first year, is **Samuel O. Sostre**, who you may have known as Oliver. Oliver is currently a lieutenant in the army to help pay for his tuition. He writes that **John Piatkowski** is a second-year student at Albany Medical College, **David Lippe** is at MIT doing a PhD in 6.3 but will be transferring to Berkeley in September to do a PhD in math, and **Robert Crockett** is going to Berkeley in September to begin a PhD in physics.

Oliver Chow is finishing his second year at Monitor Co. in Cambridge. This summer he will be leaving the firm to travel around the world before returning to Sloan for MBA studies this fall. . . . **Becky Witttry** is in Austin working for Motorola. She really likes it there—the pay is great but the hours still stink (11:30 p.m. to 8 a.m.). It looks like a first shift job is coming her way soon though. **Kim (Jeffries) Gibson** also works for Motorola, but in Scottsdale, Ariz. Her husband, John Gibson, '94, is in law school at Arizona State.

Eric Heit has been working for Intel in Folsom, Calif., for over a year. He recently completed a two-month temporary assignment in Hillsboro, Ore., and is happy to be back home in California. "Now that I don't have problem sets keeping me up every night, I've found some time to volunteer. I've started tutoring

ClassNotes

high school students, and participating in National Engineers' Week. After the holidays, I plan to become a Big Brother." . . . **Julie Stein** has been working for Intel in Albuquerque for the past year and nine months. This summer she took some time off before starting law school in the fall.

From **Steve Chamberlin** at <slc@atlantis.mak.com> we learn that he is "still living and working just down the street from the 'Tute, in scenic Central Square." He shares an apartment with four other MIT grads: **Len Granowetter**, **Pete Tarsi**, **Yev Gurevich**, '94, and **Hugh Morgenbesser**, '94. Len and Steve work at a small Central Square start-up company, doing virtual reality networking software. **Dave LeCompte** works there, too. . . . **Derek Atkins** finished up a master's degree at the MIT Media Lab this May. Before graduating he helped coordinate the factoring of RSA-129, a worldwide project of 600 people in 25 countries to crack the long-standing challenge (presented in 1977 by three MIT scientists).

Yoshimasa Ito and **Michael Cabot** are both in Japan. Yoshimasa Ito is beginning research for a master's thesis for an MIT degree, but is doing a year's research at the Univ. of Tokyo, Faculty of Urban Engineering. He should be there until next July or so. Michael Cabot is now working for Fuji Silysia Chemical, Ltd., manufacturers of raw materials for the paints, plastics, and beer industry. Although based in Nagoya, Japan, Michael spends the majority of his time on the road with about half of it in Portland, Ore., in his role as a technical and



The wedding of Julie Temple, '90, and Hal Cohen, '87, in Woodford, N.Y., was the excellent excuse for an MIT reunion. From left (front): Jay Cohan, '87; Ken Malsky, '90; Joe Cerami, '86; Todd Ogawa, '87; Andy Gerber, '87; Tom Wethern, '90; Andy "Muenz" Muenz, '90; Pete Andrews, '89; Claudio Goldbard, '89; Bill Habeck, '87; Adam Rosen, '88; and Tom Woodman, '90.

Back row: Paulo Pereira, '94; Brecht Isbell, '91; Jen Duncan, '92; Ellen (Maker) Malsky, '88; Nicola Bird, '91; Marie Coppola, '90; Carmita Signes, '90; the bride and groom; Dee Hall, '89; Cynthia (Esperson) Tronco, '97; Toby Sanders, '90; Jim Koenig, '87; Stephanie (Levin) Koenig, '87; Claudia Markovich, '84; Roberta Lovato, '86; Steve "Benny" Stein, '88; and Robert Lenoil, '86.

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David Kreutzer
David Packer, SM '63
Donald Seville, SM '94
Kristina Wile, SM '94
Virginia Wiley

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marketing representative. . . . Alex Wu returned in July from a year-long internship at Fujitsu Laboratories in Kawasaki, Japan, (about 20 miles southeast of Tokyo) as part of the MIT Japan Program.

In June, Robert Wickham completed a master's in airline operations in the Aero and Astro Department at MIT. This fall he will take a job with the Boston Consulting Group in New York City. In the interim he will be going to Indonesia for the summer to teach airline operations at a university there. . . . Tim Kutscha now works at Hewlett Packard after getting a master's in engineering from MIT earlier this year. He went water skiing for the first time and enjoys backpacking in the Sierra mountains of Northern California. After working at HP a few years, he hopes to move to the Pacific Northwest for the long term. . . . Ken Ricci is working with tunable lasers and researching molecular dynamics in the second year of a physics PhD at Stanford. He unwittingly volunteered to organize the 1994 fall reception for the MIT Club of Northern California, and has met a lot of cool Bay Area people as a result. From time to time Ken gets together with Paulo Correia and Jon Doan to make homemade pizzas in the Bertucci's style. Paulo is finishing a master's in ME at Stanford (after recovering from a broken collarbone earned in a cycling race), and Jon is in his second year of a Stanford PhD in materials science. Also at Stanford is Eric Ly, who is pursuing a PhD in computer science. Fintan Ryan, who finished a VIII/VI double major a year early in May 1992, went to Stanford this summer for a conference on gravity theory. Fintan is researching gravity waves in the third year of a theoretical physics PhD at Caltech.

Rita Baranwal is in her third year of graduate school as a National Physical Science Consortium Fellow at the University of Michigan, getting a PhD in materials science and engineering. Her PhD research is in the area of "better ceramics through materials chemistry," specifically in the area of synthetic catalytic membranes. She presented her research at the National American Ceramic Society Meeting in Cincinnati in May, and also will be presenting a paper at the Materials Research Society Conference in Boston after Thanksgiving. Rita "really enjoy(s) being back in the Midwest, and being in Ann Arbor is fantastic."

Some quick updates: Masahiro Arakawa is in his second year at USC, and complains that his thesis project is nothing but grief. . . . Frank Chen works for Intel in Santa Clara but flirts with the idea of going to dental school. . . . Claudia Abendroth is working hard at Merck in New Jersey. She and Peggy Hsieh, '92, are roommates. . . . Rita Nanda is at U of Chicago med school studying very hard. . . . Lawrence Ward got a 6.1 master's from Georgia Tech and is working at David Sarnoff Research Center in Princeton, N. J. . . . Bethany Foch is at MIT working on a master's in mechanical engineering in the field of advanced composites and working for a small boat manufacturer in Concord, Mass. . . . Hsin-Chien Tai is a second year grad student at Rutgers University in chemical engineering. Hsin-Chien passed the qualifiers in May and is now working with patterned substrates and dorsal root ganglion from chick embryos. . . . Daniel Schwartz, who has completed his second year of medical school at the Washington

University School of Medicine in St. Louis, was recently awarded the Park J. White, M.D. Prize for outstanding performance in the first-year courses offered by the Program for Humanities in Medicine.

Alice Yates graduated in June with a master's degree from the Technology and Policy Program. . . . Christopher R. Wren is engaged to Donna Khodarahmi, '91. Chris returned to MIT as a grad student in the EECS department. He works in the Media Lab's vision group, and is trying to get used to taking classes again. . . . Leah (Reingold) Gordon married D. Ben Gordon, '94, in June. Leah finished an SM at MIT (Course I-E) in August 1994, and both she and Ben are now at Caltech, trying to get PhDs while playing as many hours of uni-hoc as possible. . . . On April 22, Bridget (Banks) Smyser married Robert Smyser at the MIT chapel. Rob manages the computer labs for the Architecture and Urban Planning Departments at MIT. Kristen Nummerdor and Teresa (Ranck) Marshall were in attendance. Bridget passed her qualifying exams in February and is now working on a PhD in materials engineering at WPI in Worcester.

Sean Dougherty reported in an earlier update in the 1992 column about spending time in China, getting married to Yan Sima (of Beijing), and studying International Relations at Rice University (in chronological order). He has just finished a master's degree in political science from Rice. After traveling to Taiwan and elsewhere in his job search, he settled into a market research position in New York at Columbia House, where he is analyzing the music industry. He continues to consult on political risk and hopes that he can get involved in the development of Asian markets in the near future. . . . Stacey Reeves works for Intel in Oregon and makes periodic trips to Albuquerque. She has moved in with someone, and is learning the joys of home owning. "I never thought I had it in me to spend my weekends working on the yard and all my money redecorating, but funny things happen when you get to be an adult." Stacey also reports that Kerry Forbes is getting married this summer to Mark Hanault.

Tina Chou has sent a picture and an update. Tina received a master's in engineering from MIT last year and is now working for the Department of Defense. . . . Mike Schlamp is a second-year chemistry PhD student at UC Berkeley. . . . Diana Roccograndi is having fun waitressing and farming in Vienna, Va. . . . Brian Rosenberg is a mathematician at the Department of Defense and is enjoying his new townhouse in Columbia, Md. . . . Jee Ahn is a management consultant with the Mitchell Madison Group in New York City. . . . Jeff Jhang is a third-year student at Mt. Sinai in New York City. . . . Rima Woo has graduated in Course IX in June and is doing research in biochemical sciences at MIT before going to medical school.—Mari Madsen, secretary, 85 Alberta Rd., Brookline, MA 02167; tel: (617) 469-0992; Sophia Yen, e-mail correspondent, <syen@itsa.ucsf.edu>

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Please send news for this column to: Jeff Van Dyke, secretary, 23 Symphony Rd., Apt. 4, Boston, MA 02115; tel: (617) 859-7760; e-mail: <jvandyke@mit.edu>

CourseNews

CIVIL AND ENVIRONMENTAL ENGINEERING

Laurens D. Van Der Tak, CE '88, writes: "I am a water resources engineer at CH2M HILL. I recently spent 10 months in Hungary working on water quality management issues, including an organizational study of the entire water sector following the change from socialism to market-oriented management of utilities." . . .

Jonathan Richmond, SM '81, PhD '91, writes via e-mail: "I am the first visiting professor of transport planning at the University of Sydney's New South Wales Department of Transport. The position was established to bring an international visitor each year to teach regular classes, provide seminars for professionals, and advise the New South Wales government on transport policy. I am also delighted to tell you that my MIT dissertation, "Transport of Delight—The Mythical Conception of Rail Transit in Los Angeles" has been accepted for publication by Johns Hopkins University Press. I would be pleased to hear from other alumni/ae "down under." . . . MIT J.R. East Professor **Joseph Sussman**, PhD '68, has been nominated as a member of the board of directors of ITS (Intelligent Transportation Systems) America. He will represent the interests of the academic and research communities in a board that he feels has previously been dominated by government, industry, and association representatives. As chairman of the Transportation Research Board executive committee, Sussman presided over the annual meeting in January, which attracted a record 7,200 participants.

The Association of Alumni and Alumnae was notified that **James Francis Stroker**, SM '37, of Humble, Tex., died on May 8, 1993. No further information was provided.

Alumni/ae may send information for *Course News* to <mitalum@mitvmc.mit.edu>.

Do You Recognize This Face?

.....

It's SADIK KAKAC, SM '59 (II), SM '60 (XXII) who sent us the following note: "I am trying to find my three American roommates from Graduate House. I came from Turkey in 1958 to study at MIT." Kakac would like his roommates and any of his other friends from his days at MIT to contact him at the University of Miami in Coral Gables, Fla., where he is a professor of mechanical engineering.



Lynch, ScD '68. "I am building up a longer range R&D group investigating issues ranging from biomechanics to microclimates in footwear. Two other Course II alumni have joined our R&D team: **Kjirste Carlson Morrell**, '84, SM '86, PhD '93, and **Yiping Qiu**, who completed his post-doc at MIT in 1994. After spending 12 years away from the world of mechanical engineering in advanced software with Digital and General Electric, I am enjoying renewing acquaintances with my old colleagues working in fibers, polymers, and applied mechanics. I have kept close contact with MIT, particularly through my two sons: **Tim Lynch**, SM '94 (XV), and **Mike Lynch**, who is in the Leaders for Manufacturing Program in the Sloan School of Management and the Department of Mechanical Engineering."

. . . **Richard E. von Turkovich**, SM '82, writes: "I am a VP at Design Continuum, a product

design and development company located in Newton, Mass. I urge any old friends, or anyone needing product-design help to give me a call." . . . MIT Professor of Mechanical Engineering and Director of the Industrial Program for Structural Acoustics **Richard H. Lyon**, PhD '55 (VIII), writes: "I received the Rayleigh Medal from the (British) Institute of Acoustics at its spring meeting in Liverpool in May. In part, the citation acknowledged 'continuing leadership in research in structural acoustics.' I was also inducted into the National Academy of Engineering and cited for 'development of statistical energy analysis and machine diagnostic techniques.'"

MATERIALS SCIENCE AND ENGINEERING

Thomas W. Eagar, '72, ScD '75, '88 (XVE), succeeded **Mert Flemings**, '51, SM '52, ScD '54, '78 (XVE), as the head of the MIT Department of Materials Science and Engineering in mid-January. . . . **Elizabeth P. Berger**, PhD '93, writes: "I am a Peace Corps volunteer in Wewak, Papua New Guinea, where I teach high school science." . . . "Since retirement," writes **Joseph R. Lane**, ScD '50, "I have played in several orchestras as a second-rate amateur fiddler. However, I may be the only metallurgist who has performed at Constitution Hall and the Kennedy Center in Washington, D.C., Carnegie Hall in New York, the Esterhazy Palace in Hungary, and in Wales, London, and Russia. . . . **Jennifer Lewis**, ScD '91, assistant professor of materials science and engineering at the University of Illinois/Urbana-Champaign (UIUC), was selected to receive the National Science Foundation's 1994 Presidential Faculty Fellow Award. The award, which provides \$100,000 per year for up to five years to support research activities, is given to "young faculty members who demonstrate excellence and promise in both scientific or engineering research and in teaching." **Lewis** joined the faculty of UIUC in 1990. Her research group currently focuses on how

MECHANICAL ENGINEERING

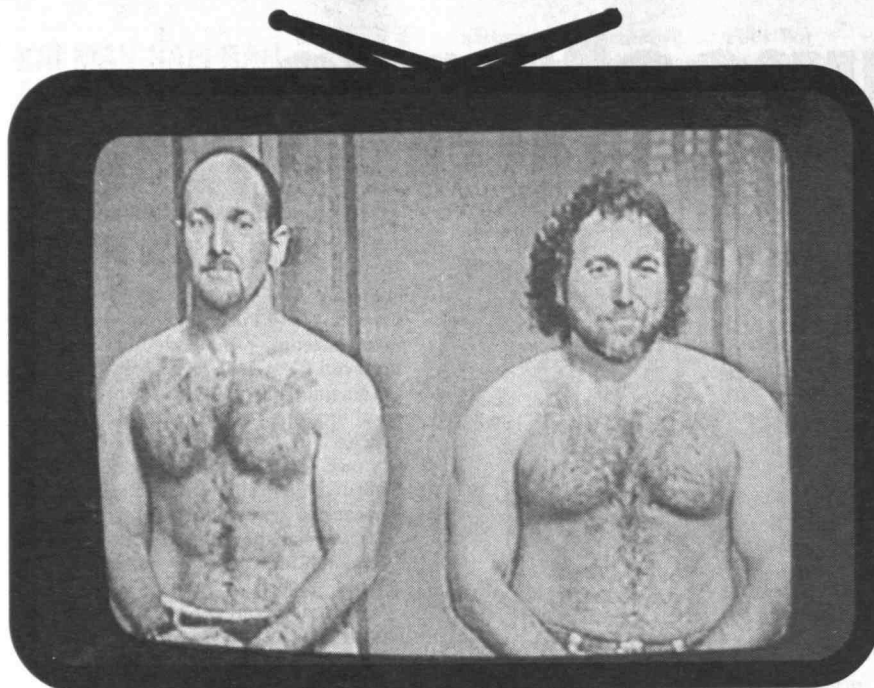
"I am now director of R&D at The Timberland Co. in Stratham, N.H.," writes **Frank**

DEGREE CODES

AE	Aeronautical Engineer
BE	Building Engineer
CE	Civil Engineer
CHE	Chemical Engineer
CSE	Computer Science Engineer
DPH	Doctor of Public Health
EAA	Aeronautical & Astronautical Engineer
EE	Electrical Engineer
EGD	Doctor of Engineering

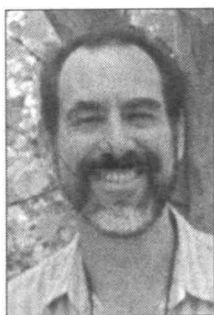
ENE	Environmental Engineer
MAA	Master in Architecture Advanced Studies
MAE	Materials Engineer
MAR	Master in Architecture
MCP	Master in City Planning
ME	Mechanical Engineer
MET	Meteorologist
MIE	Mineral Engineer
MME	Marine Mechanical Engineer
MNG	Master in Engineering

MPH	Master in Public Health
MTE	Metallurgical Engineer
NA	Naval Architect
NE	Naval Engineer
NUE	Nuclear Engineer
OCE	Ocean Engineer
PhD	Doctor in Philosophy
ScD	Doctor of Science
SE	Sanitary Engineer
SM	Master of Science



Joel Lederman, '77 (II,X), SM '79 (II), (right) and his brother, David, appeared in February on the Late Show with David Letterman where they flexed their chest muscles to "Dueling Banjos" during the Stupid Human Tricks segment. Lederman writes: "This was similar to my Gong Show performance some of you may remember from August 1977." The brothers repeated their amazing feat on the Maury Povich Show in March.

organic macromolecules influence the structure and properties of inorganic colloidal suspensions and the particulate films fabricated from such systems. The ultimate aim of their research is to build upon this understanding to design nanoscale particulate-derived films with controlled architectures. Lewis was awarded the 1994 Burnett Teaching Award in the UIUC Department of Materials Science and Engineering.



David Bromer

on rare books, Bromer had worked for Gillette. . . From Singapore, Salil K. Roy, ScD '66, writes: "I am now an associate professor of building materials at the National University of Singapore. I offer three undergraduate courses (building science, principles of building materials, and corrosion of building materials) and teach one course (materials technology) to the postgraduate students. My research is concentrated in the areas of deterioration of building materials and application of materials science in understanding building defects. I also help industry in solving problems in construction and maintenance of buildings."

Richard H. Millar, '70, SM '71, of Saunderson, R.I., writes: "I am currently the VP and general manager of the Rhode Island and Southern California operations for Leviton Manufacturing Co. We produce electrical wiring devices and have plants in Warwick, R.I.; San Diego, Calif.; and Tijuana and Tecate, Mexico. Programs include total quality, ISO9000, JIT, and work cells. My responsibilities have recently increased to include all product management and product development. I have been happily wed to my wife, Maria, for 16 years. I am an obsessive golfer and philatelist and am active in community and church activities."



Paul Gault

cal process control engineer, and principal statistical process control engineer. In 1989, Gault moved to the Faircrest Steel Plant as area manager of ingot making and section manager of scheduling and logistics. Most recently he held the position of project member for detail planning in the steel business unit. The Timken Co. is a leading manufacturer of highly engineered bearings and alloy

Paul A. Gault, '82, SM '82, was named the manager of tube business advancement for The Timken Co.'s steel business. Gault started with the company in 1982 as a research engineer. The following year he moved to the Harrison Steel Plant, where he held the positions of steel modernization specialist, senior statisti-

steels. The company employs 16,000 people worldwide and recorded 1994 sales of more than \$1.9 billion.

The Association of Alumni and Alumnae was notified that **David Charles Hill**, SM '59, of Attleboro, Mass., died on September 18, 1994. No further information was provided. *Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.*

IV ARCHITECTURE

Gregory Faulkner, MAR '87, writes: "I opened my own architectural practice, Architects Faulkner & Ryan, in 1994. We now have six employees working on residential, commercial, and institutional projects. We have ongoing work in Ohio, Nevada, and California." . . . **Mark W. Vande**, MAR '70, reports: "My projects include the Church of Latter Day Saints and various historical museums in New York." . . . **Larry Vale**, SM '88, writes: "I have been promoted to associate professor at MIT in Course XI. I have also received a Guggenheim Fellowship for 1995-96 to pursue research on public housing redevelopment." . . . "After commuting 90 miles each way," writes **Robert R. Ferens**, MAR '48, "to attend alumni meetings each month in the winter season, it was wonderful to relocate to Sarasota, Fla. It is a very humane city with a devoted and fine group of MIT alumni/ae. We may be many miles from Cambridge, but the Institute does a great job making us feel connected." . . . **Grace Cheng**, SM '94, was hired as a junior architect at RTKL Associates, Inc. in Los Angeles. The firm's domestic and international portfolio includes retail, planning and urban design, mixed-use, office, hotel, resort, government, and health sciences projects.



Paula Krugmeier

Paula Krugmeier, MAR '80, was elected VP of Backen Arrigoni & Ross, Inc., in San Francisco. She is currently a project architect on a number of multi-family housing developments in the Bay Area. . . . **Jamel Akbar**, MAA '81, PhD '84, was elected chairman of the board of Umrans (the equivalent of the American Institute of Architects) in Saudi Arabia. . . . Two PhD candidates in the History, Theory, and Criticism of Art and Architecture section, **Samuel Isenstadt**, MAR '85, and **Rejean Legault** were nominated for fellowships by the Center for Advanced Study in the Visual Arts at the National Gallery of Art. . . . **Ann Beha**, MAR '75, received the Lifetime Achievement Award from the New England chapter of the Victorian Society in America.

Bill Rawn, MAR '79, was recently featured in the *Boston Globe*. *Globe* correspondent Robert Campbell reviewed "William Rawn Architects: Ideas of City, Celebrations of Place" at Roger Williams University in Bristol, R.I. Campbell described the exhibit as "intriguing" and said the Back of the Hill housing in Boston [several blocks of afford-

able row houses in Mission Hill] and Seiji Ozawa Hall at Tanglewood "stand out among Rawn's achievements."

Sandra Howell, professor emeritus and senior lecturer at MIT, received a career achievement award from the Environmental Design Research Association. In part, the citation reads: "Across her professional career, Sandra Howell has advanced the developing theory and practice of environmental psychology with intelligence, wit, and rigor. Through her ground-breaking early research on patterns of use in senior housing, Sandra Howell provided the guidelines for community-sensitive senior housing design. And a dedication to 'knowledge transfer' by Sandra Howell and her students has brought these ideas into the architecture of senior housing around the country. Sandra Howell's thoughtful voice contributes to our understanding of the cultural context of age and gender, as well." . . . In recognition of "advanced and interdisciplinary research in the field of cultural and social practices," MIT's Aga Khan Associate Professor Attilio Petruccioli was awarded a prize by *editions iichiko of Tokyo* for "Fathpur Sikri."

The Association of Alumni and Alumnae was notified that Irving W. Isaacs, Jr., MAR '40, of Newtown, Pa., died on March 9, 1995. Isaacs had retired from the George M. Ewing Co. of Philadelphia where he had been an architect. Isaacs's son, Andy, said that the family has set up the Irving W. Isaacs (1940) Memorial Fund to support needy graduate students at MIT in honor of his father's three loves: architectural design, mentoring young architects, and MIT. . . . The Association of Alumni and Alumnae was notified that John Lindstrom, MAR '41 of Fountain Hills, Ariz., died on March 14, 1995, and Eric William Thrift, MAR '38, of Kingston, Ontario, died on February 12, 1995. No further details were provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

V CHEMISTRY

Stephen Lippard, PhD '65, the new head of the MIT Department of Chemistry and the Arthur Amos Noyes Professor of Chemistry, received the 1994 William H. Nichols Medal of the American Chemical Society's New York Section. Lippard was cited "for creative contributions in bioinorganic and organometallic chemistry, characterized by extraordinary breadth and depth, that have profoundly stimulated researchers and disciplines." The society said that Lippard ranks among pioneers of bioorganic chemistry, lifting the study of metal-nucleic acid interactions from biochemical empiricism to studies of basic coordination chemistry. Lippard's many fellowships and awards include election to the National Academy of Sciences and the National Institute of Medicine, the Ballard Medal, and the ACS Award for Distinguished Service in Inorganic Chemistry, and election as Fellow of the American Academy of Arts and Sciences.

Barbara Schowen, PhD '64, reports: "In April, I was promoted to full professor in the Department of Chemistry at the University of Kansas. I am also associate chair for under-

graduate affairs. One of our bachelor's graduates, Matthew P. Meyer, will start graduate work in chemistry at MIT this fall."



Howard Simmons

structures for synthetic enzymes and catalysts. As a research leader, Simmons expanded DuPont's fundamental research into the life sciences, imaging, and electronics. As VP for R&D, Simmons is credited with attracting top talent to the company. In 1992, he was presented with the National Medal of Science by President George Bush.

David Gladstone, ScD '89, writes: "Lisa and I are happy to announce the birth of Jaden Isaac on September 9, 1994. In other news, I have made the first real-time in-vivo measurement of a radiation dose absorbed in a mouse tumor after receiving radio-labeled antibodies. The detector was a small MOSFET inserted into the tumor's center. I have just finished installing a new intraoperative radiation-therapy machine at Harvard Medical School and have been nominated for the rank of assistant professor. I have finished building and now play a five-string viola, which means Lisa no longer has to capo up and retune her banjo." . . . David M. Hercules, PhD '57, of Nashville writes: "I have taken on a new challenge as centennial professor and chair of the chemistry department at Vanderbilt University. I am continuing my research on analytical chemistry of surfaces and solid-state mass spectrometry." . . . Robert Laudise, PhD '56, adjunct research director for chemistry at AT&T Bell Laboratories, was honored for

Howard E. Simmons, Jr., '51, PhD '54, a chemist and research leader at DuPont for 38 years, was honored by the company with the Lavoisier Medal for Technical Achievement. The guest speaker at the ceremonies was MIT President Charles M. Vest. As a chemist, Simmons' work led to a new class of

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attaining distinction in his field at his alma mater, Union College in Schenectady, N.Y., with the Nott Medal. Laudise's fundamental research on the physical chemistry of crystal growth has contributed to commercial applications in frequency control and timing functions in modern electronics. To recognize his research, the International Organization for Crystal Growth established the Laudise Prize. Laudise joined Bell Laboratories in 1956 and is a member of the National Academy of Sciences and the National Academy of Engineering.

The Association of Alumni and Alumnae was notified that Elmer Nielsen, PhD '50, of El Cerrito, Calif., died on June 9, 1993. . . . In the May/June issue, we misidentified the class year for Professor Edward A. Mason, PhD '51, of Barrington, R.I. Professor Mason died on October 27, 1994.

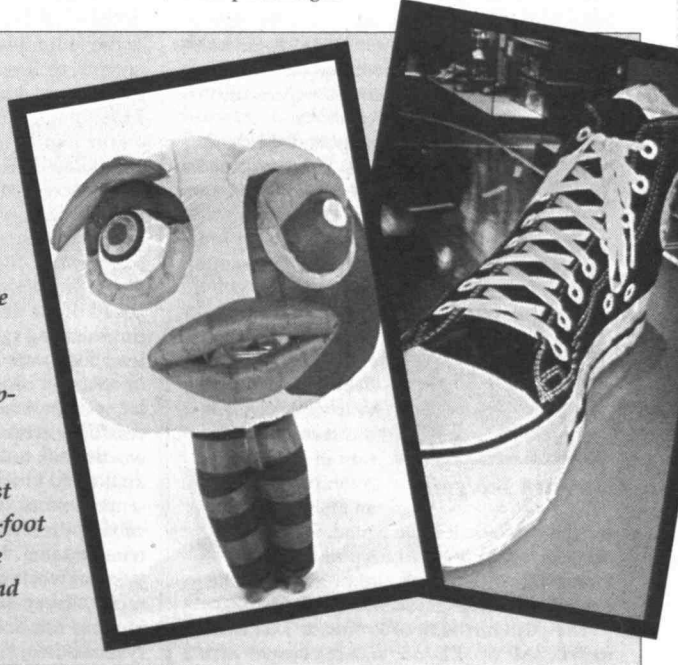
Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Khaled E. Ismail, PhD '89, a research staff member at the IBM Thomas J. Watson Research Center, was named Outstanding Young Electrical Engineer of 1994 by Eta Kappa Nu, an honor society for electrical engineers. While a post-doctoral fellow at IBM, Ismail revolutionized the use of two-dimensional electron gas transport in viable silicon-based devices. His new structures, used in building high-speed transistors, enabled electrons to flow with greater ease. More recently, he has focused on optimizing the electrical properties of thin layers of a related alloy, a mix of silicon and germanium, to improve electrical materials by factors rather than percentages.



Jonathan Goldman, SM '85, and his wife, Nicole, recently celebrated the 10th anniversary of their Boston-based company, Goldman Arts. The Nickelodeon Channel, folk singer Laurie Anderson's new tour, and SeaWorld have used their designs for inflatable sculptures, banners, and other products. Pictured are an inflatable costume for First Night Boston and a seven-foot long, foam-filled Converse sneaker at the New England Sports Museum.

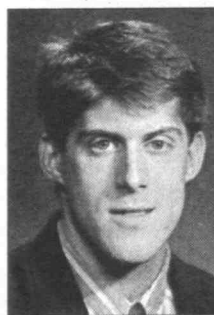




In April, Vice-President Al Gore unveiled the National Environmental Technology Strategy, a blueprint for strengthening the U.S. environmental-technology industry, at Molten Metal Technology (MMT), an environmentally ambitious hazardous-waste processing company in Fall River, Mass. Pictured with Gore are Chris Nagel, ScD '91 (left), executive VP, and Bill Haney (right), president and CEO, who founded the company after John Preston of the MIT Technology Licensing Office brought them together. The company has retained its ties to MIT through its technical advisory

board, which includes Professor Merton Flemings, '51, former head of the Department of Mechanical Engineering; Professor Adel Sarofim, ScD '62, from the Department of Chemical Engineering; Jefferson Tester, PhD '71, director of the Energy Lab; and John Preston. MMT based its entry into the market on a technology, which Nagel conceived while working in the steel industry and then developed as his doctoral thesis project, that relies on the ability of molten metals to break down the chemical bonds in compounds so that their constituent elements can then be reused.

Prior to joining IBM full-time, Ismail taught at Cairo University from 1990 to 1994. He holds four patents with three pending. He has written or co-written more than 70 papers and contributed chapters to five books.



Stephen Feldgoise

for the Amherst Rescue Squad. I am chair of the Merrimack Valley group of the New Hampshire Sierra Club and president of the Middlesex Canal Association.

The 60th birthday of Professor J.G. Krishnaya, SM '60, EE '60, was celebrated with a

Stephen J. Feldgoise, '92, SM '93, joined the General Electric R&D Center on the Manufacturing Management Program.... Nolan Jones, SM '54, writes: "Joan and I moved to Amherst, N.H. in February 1994. This year we celebrated our second anniversary in March. I recently qualified as an ambulance driver

colloquium and luncheon on April 12, 1995 at the Hotel Blue Diamond in Pune, India. A number of Krishnaya's closest associates, friends, and students attended, reported Lou Rosenblum, '42 (XVIII). Krishnaya spoke on the importance of a value system and societal obligation. He referred to his father as the person who influenced him the most. Krishnaya's students from the Indian Institute of Management wrote in the invitation to the celebration: "Professor J.G. Krishnaya is one of India's visionaries. He has always been ahead of his time. He installed India's first time-sharing system at IIM, Ahmedabad at least five years before any other educational or research institute in India installed a similar system. A high-class engineer and a successful systems theorist, to him, no theory is worthwhile unless it can be applied, and applied to India's betterment. He has done seminal work on applying systems theory to solving problems in the area of public systems in India. In recent times, he has done original work in the area of computer cartography. Every one of us who has worked with him has not only learned operations research, systems theory, and computer science from

him, but, as importantly, professionalism, integrity, hard work, human relations, commitment, and patriotism."

Enrico I. Ancona, '67, SM '68 writes: "After many years at DEC, I've moved to Polaroid, where I am executive VP and responsible for electronic imaging."



George Zames

McGill Professor George Zames, ScD '60, won the 1995 Isaak Walton Killam Prize, Canada's top award in science. Zames was recognized for introducing the input-output theory of nonlinear feedback in 1960 and the H^∞ system theory. In May 1994, a two-day conference, "Feedback Systems, Non-

linear Control and Complexity," was held in his honor in Montreal. When he was 5 years old, Zames escaped from war-torn Poland and found refuge in Montreal. At 15, he started studying engineering physics at McGill and graduated at the top of his class. He went on to study at the Imperial College of London University and MIT. He worked for MIT, Harvard, and NASA before returning to McGill as a professor in 1974.

Levin Wilson Foster, SM '30, of Goose Creek, S.C., died of heart failure on December 12, 1992. During his 35-year career at GE, Foster made many notable achievements including service as program manager on the development of the guidance system for the Minute-Man missile and designer/manager of a plant in Irmo, S.C., that produced a highly advanced capacitor and earned him the GE Specialty Capacitor Citation. After retiring from GE, he spent the following 10 years as a technology-utilization officer with the Small Business Administration, which awarded him its Merit Service Award. He later established a small business, Nantronics, and developed and produced an updated transistorized version of the metronome. Foster enjoyed classical music and played the clarinet for many years. In 1935, he published "A Directory of Clarinet Music." He wrote a total of 26 books, of which 22 were published. At the time of his death, he was working on a book entitled *I Write for Fun and Not for Money*.

The Association of Alumni and Alumnae was notified that Lawrence Jerome Levine, SM '47, of Valley Stream, N.Y., died on October 9, 1994. No further details were provided.

Alumni may send information for Course News to mitalum@mitvmc.mit.edu.

VI-A INTERNSHIP PROGRAM

In my last article, I overlooked a first and unusual occurrence for VI-A. The annual business meeting & dinner on March 6 was attended by four directors of the program: Professor J. Francis Reintjes, 1960-69 and 1993-94 (ad interim); John A. Tucker (H '85), 1969-1987; Kevin J. O'Toole, SM '57 (XIII), NE '57, 1987-93; and present director Professor Markus Zahn, '67, SM '68, EE '69, ScD '70. All attended the annual dinner, which was

Biology Alumnus Needs Transplant

Without a matching marrow transplant, Alan Kuo, SM '90 (VII), PhD '95 (VII), age 31, will die of chronic myelogenous leukemia. Several of Kuo's friends and fellow graduate students from the MIT/Woods Hole Oceanographic Institution Joint Program are working with the HLA (Human Leukocyte Antigen) Registry Foundation to find a compatible marrow donor. Searches of all available registries have failed to produce a match for Kuo.

Individuals between the ages of 18 and 55 can call the HLA at 1-800-336-3363 to schedule a blood test that determines tissue type. Marrow transplants require matching certain tissue traits of a donor with the patient. Although a marrow match can be made with a donor from any racial or ethnic group, Kuo's most likely match will be an Asian or Pacific Islander. However, once in the database, prospective donors may learn that they are able to help one of the 16,000 adults and children who are diagnosed annually in the United States with leukemia, aplastic anemia, or another of 60 fatal diseases for which a marrow transplant is the only chance for survival. Those outside the

U.S. may contact the National Marrow Donor Program through the Internet at <dtaylor@nmdp.org>.

The HLA Registry Foundation has established a fund for donations to help defray the cost of the marrow typing procedure, which is the first step in finding a match for Kuo. Federal funding covers the typing costs for minorities because there is a shortage of minority donors, but does not cover the \$50 fee for Caucasians. Tax deductible contributions may be sent to Friends of



Alan Kuo, c/o HLA Registry Foundation, 70 Grand Ave., River Edge, NJ, 07661. Checks should be made payable to Friends of Alan Kuo.

While working toward a master's degree in biology at MIT, Kuo studied the molecular biology and genetics of viral and cellular oncogenes in rat cells at the Center for Cancer Research. He then joined the MIT/WHOI Joint Program in Oceanography, where he examined the genetics involved in the bioluminescence of the marine bacterium, *Vibrio fischeri*. Kuo is now studying the genetics of cancer in the yeast *Candida albicans* as a post-doctoral fellow at the University of California/San Francisco. □

held at the MIT Faculty Club. Afterwards, the VI-A company representatives adjourned to the open house in the Grier Room.

As the selection process drew to a close in early May, Zahn was pleased to report that the program is "very healthy." There are many EECS students wanting the opportunity to be engaged in challenging work assignments and thesis research. From about 150 applications, 83 students were matched with companies. Total enrollment is approximately 210 and will remain about the same for the next academic year.

Financial support for students on graduate

work assignments is improving. Currently offering their own financial support programs are AT&T Bell Labs; Bolt, Beranek & Newman; Jet Propulsion Laboratory; Draper Laboratory; and Lincoln Laboratory. IBM, COMSAT, Silicon Graphics, and SatCon Technology have joined the newly instituted VI-A Fellowship Program, which requires only a small additional expense to the VI-A companies over paying salaries. This is a one-term stipend that at a minimum matches a research assistantship stipend and pays tuition and medical insurance. Zahn expects that other VI-A companies will join the

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program.

Anyone having access to the World Wide Web can view the latest VI-A information at: <<http://www-eccs.mit.edu/via.html>>. This page is linked to the Department of Electrical Engineering and Computer Science home page at: <<http://www-eccs.mit.edu>>.

The biennial meeting of the Department's visiting committee took place in May. Established in 1875, visiting committees are appointed by the MIT Corporation and are composed of Corporation members, alumni/ae, and other professionals with expertise in various areas related to a department. Over the years, a number of appointees to the EECS Committee have been VI-A grads. This year VI-A Corporation members include: Joseph F. Keithley, '37, SM '38; Professor John G. Linvill, '43, SM '45, ScD '49; Raymond S. Stata, '57, SM '58; and Dr. Andrew J. Viterbi, '56, SM '57.

More recent graduates of VI-A will know Mrs. A. Lucy Allen, whom I hired in July 1984 to help Lydia Wereminski with the burgeoning size of VI-A enrollment. Lucy retired June 9. If anyone wishes to drop her a note, they may do so c/o the VI-A Office, Rm 38-473. She gave wonderful assistance to many individuals and to the running of the VI-A Office. We thank her and wish her well in the years ahead!

Since my last article, I've had many contacts with VI-A alumni/ae. Vincent W. S. Chan, '71, SM '71, EE '72, PhD '74, who stopped by to say hello, was recently promoted to head of the communication division of Lincoln Laboratory. . . . Jeffrey D. Beck, '71, SM '72, recently became director of Texas Instrument's involvement in VI-A. . . . Professor Robert M. Gray, '64, SM '66, vice-chair of electrical engineering at Stanford, spent the spring on sabbatical visiting Harvard and Brandeis. He co-wrote *Fourier Transforms: An Introduction for Engineers*. . . . Alan M. Marcum, '78 (XV), '79, SM '79, announced that his family grew to four with the birth of Rachel Helene Marcum in April. . . . By chance, I met Herbert W. Mower, '65, SM '67, EE '68, ScD '72, at Babson College, where we both attended a joint meeting of the Wellesley Historical Society (of which I'm 1st VP) and the Eastern Massachusetts Chapter of the American Theatre Organ Society. I was reminded how long I've been at MIT when I met Eric A. Slutz, '74, SM '75, in Lobby 7. Slutz was on campus escorting his 17-year-old son, Ian, on the college search trek. —John A. Tucker, director (emeritus) and lecturer, VI-A Program, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139-4307; e-mail: <jat@fenchurch.mit.edu>.

VII BIOLOGY

Clemens E. Prokesch, SM '45, writes: "I was elected Fellow of the American College of Physicians last year. In March, I was inducted

at the convocation at the college's annual convention in Atlanta, Ga. I can now place "F.A.C.P." after "M.D."

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

VIII PHYSICS

Via e-mail, Steven E. Koonin, PhD '75, writes: "I recently became VP and provost of Caltech. Since receiving my doctorate from MIT, I have been a professor of theoretical physics here."

John T. Ho, PhD '69, professor of physics and associate dean of natural sciences and mathematics at the State University of New York at Buffalo, reports: "The SUNY Board of Trustees has named me a Distinguished Service Professor, the highest faculty rank in the state university system."

MIT Professor of Mechanical Engineering and Director of Industrial Program for Structural Acoustics Richard H. Lyon, PhD '55, writes: "I received the Rayleigh Medal from the (British) Institute of Acoustics at its spring meeting in Liverpool in May. In part, the citation acknowledged 'continuing leadership in research in structural acoustics.' I was also inducted into the National Academy of Engineering and cited for 'development of statistical energy analysis and machine diagnostic techniques.'"

George R. Donner, Jr., PhD '69, reports that he is VP and trust investment officer

at Fort Wayne National Bank in Fort Wayne, Ind.

James Willans Davisson, PhD '43, of Oxon Hill, Md., died on February 4, 1995, from a heart attack. In 1976, Davisson had retired from the Naval Research Laboratory as a solid-state physicist. He was an ardent nature lover with a particular interest in birds and minerals. One of his greatest pleasures was walking to observe nature and to add to his various collections of natural objects.

The Association of Alumni and Alumnae was notified that Joseph Morgan, PhD '37, of Oakton, Va., died on April 30, 1994; Harold Thomas Smyth, PhD '36, of East Brunswick, N.J., died on November 24, 1994; and Robert Hector Boden, SM '34, PhD '36, of Sedona, Ariz., died on February 2, 1995. No further details were provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

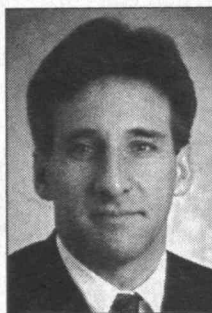
IX BRAIN AND COGNITIVE SCI-

"I will complete a two-year NIMH post-doctoral fellowship at the University of Illinois this summer," writes Neal Pearlmuter, PhD '93. "I will then start an assistant professorship in the psychology department at Northeastern University."

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

X CHEMICAL ENGINEERING

Michael T. Klein, ScD '81, was named the Elisabeth Inez Kelley Professor of Chemical Engineering by the University of Delaware College of Engineering. Klein was recognized for his work in chemical reaction kinetics and reaction engineering. He joined the faculty at Delaware in 1981 as an assistant professor of chemical engineering. In 1991, he was



Michael Klein

appointed chair of the Department of Chemical Engineering. Klein is a member of the advisory board of the McGraw-Hill Book Series in Chemical Engineering, associate editor of *Energy and Fuels*, a consulting editor of the *American Institute of Chemical Engineers Journal*, and associate editor of *Industrial and Engineering Chemistry Fundamentals*.

He has published more than 115 articles in professional journals, and is a member of the American Association for the Advancement of Science, AIChE, and ACS.

Rakesh Agrawal, ScD '80, principal engineering associate for process cycle development at Air Products and Chemicals, Inc., was elected chair of the separations division of the American Institute of Chemical Engineers for 1995. Agrawal has been with Air Products for 15 years and is responsible for fundamental improvements to many cryogenic air separation processes. He holds 64 U.S. patents and has written 30 technical papers.

Arnold F. Stancell, ScD '62, writes: "I retired from Mobil Oil as VP for the international exploration and production business. I joined Georgia Tech as a full professor of chemical engineering. This position enables me to spend more time with my family." . . . Joseph A. Polack, SM '43, ScD '48, sends word: "For the past three years, I've run a small consulting program for owners/CEOs of closely held businesses."

The Association of Alumni and Alumnae was notified that John Edward Bell, SM '36, of Cape Coral, Fla., died on December 20, 1994; George Brown, SM '47, of Lakehurst, N.J., died on January 28, 1995; and Alexander Martin Smith, ScD '43, of Elkin, N.C., died on March 31, 1995. No further details were provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

X-A PRACTICE SCHOOL

Thin pickings this month; some of you better start writing letters or sending e-mail or faxes, or whatever you do most easily, to enable us to keep you in touch with your friends.

William J. Nicholson, '60, SM '61, has been at Potlatch Corp. in San Francisco since 1970. Just one year ago, he became director of the company's corporate energy and environmental services.

Though he now signs his name as president

Back to the Future . . . Practical Career Strategies for Future Success

October 21, 1995
10 am-3 pm
Stratton Student Center

- Develop innovative career strategies for the future with our expert consultants.
- Network with fellow alumni/ae to build future connections.
- Return to your living group to help students sponsor and strategize career opportunities.

Brought to you by . . .

Ilise Gold Life Management, L.L.C.
Change Management Specialists

&

Homecoming '95
MIT Alumni/ae Association

&

Institute Career



Assistance Network

October 22: The Annual Head-of-the-Charles Regatta
Call Theresa Joyce at (617) 253-8280 for more information.

of Shemberg USA of Searsport, Maine, **Harris J. Bixler**, '53, SM '58, ScD '60, insists he's still an engineer at heart. Having retired from Delta Chemicals, Inc., Bixler writes that he's enjoying a second career as owner of a marketing company for a Philippines manufacturer of seaweed-based food thickeners. "As part-owner of the company," he reports, "I spend a lot of time there practicing those hard-earned engineering skills." Bixler's wife, Ann, prefers Northport, Maine, to Cebu, Philippines, even in the winter; so does Bixler, when business permits. Their son, Alleson, is a Maine farmer, and their daughter, Sarah, the mother of the Bixlers' only granddaughter, is a microbiologist in Cambridge.

We're sorry to be nearly a year late in reporting the death on October 19, 1994, of **Warren E. Duerr**, SM '49, in Rochester, N.Y.

We know that Duerr spent his entire professional career with Eastman Kodak Co., first in development engineering and later in quality control, but details are unavailable.

If you want more news in this column—or even if you want it to continue at all—send word of your activities to any of the following: Carol Phillips in the SCEP office, MIT, Room 66-309, MIT, Cambridge, MA 02139, <carol@pracschool.mit.edu>; Stephanie Grepo at *Technology Review* <grepo@mit.edu>; or the undersigned at *Technology Review*, address as below, or fax (617) 258-7886.—John Mattill, Room W59-200, MIT, Cambridge, MA 02139.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

XI URBAN STUDIES AND PLANNING

Terri Y. Montague, MCP '92, SM '92 (CRE), was promoted to VP at Boston Financial. She heads the investment services team, which is responsible for investment service and operations for the public tax credit and private retail investments. Boston Financial is a diversified real estate investment firm serving the



Terri Montague

needs of institutional, corporate, and individual investors since 1969. The firm currently has more than \$5 billion in real estate assets under management. . . **Abraham Ford, Jr.**, MCP '79, MAR '79, writes: "I am the director of licenses and inspections and zoning administrator for the city of Hartford, Conn. My duties include building and trade inspections, zoning administration, housing code enforcement, and rodent control." . . . **Philip Shapira**, MCP '79, associate professor in the School of Public Policy at Georgia Institute of Technology, is a co-editor of *Planning for Cities and Regions in Japan*, published by Liverpool University Press. . . "I survived the earthquake and fire and am still living in Los Angeles," writes **Lydia Kowalski**, MCP '73. "Both were too close for comfort. I am at the UCLA School of Engineering and Applied Sciences. I

would like to hear from old colleagues." . . .

Gilberto E. Chona, MCP '91, writes: "My wife, Belkis, and I are expecting a baby boy this summer. Another MCP? Maybe!"

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

George F. Collins, SM '48, writes: "At the age of 75, I still find it hard to stay idle, so I am working as the zoning and wetlands enforcement officer for Colebrook, Conn." . . . **Grant Buma**, SM '70, reports: "I am working on a project with the Colorado River Indian Tribes, the Bureau of Indian Affairs, the Bureau of Reclamation, the U.S. Fish and Wildlife Department, the Department of Agriculture, the Soil Conservation Service, and the State of Arizona to save and protect the Colorado River."

The Association of Alumni and Alumnae was notified that **Edward Joseph Dolezel**, SM '44 (XIV), ScD '48, of Belmont, Mass., died on October 6, 1994. No further information was provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

XIII OCEAN ENGINEERING

"I am currently working on advanced vehicle hydrodynamics and maneuvering at the Naval Undersea Warfare Center in Newport, R.I.," writes **James Q. Rice**, SM '91. "I married Helen Veirs. We are having a wonderful time sailing and skiing all over New England. I plan to apply to business schools to pursue an MBA in the next few years. Yes, MIT is on my list of preferred schools. I am also interested in obtaining a professional engineer's license." . . . **Commander Leo D. Owens, Jr.**, SM '84 (II, XIII) reports: "I have a new job as an engineer officer with the USS *America*." . . . **Captain Vernon C. Honsinger**, SM '62, NE '62, has retired to the Shenandoah Valley. . . **Commander Richard D. Hepburn**, SM '88, NE '88, is the on-staff commander for Naval Surface Forces Atlantic in Norfolk, Va. . . **Lieutenant Commander Gary W. Edwards**, SM '92, OCE '92, recently received the Navy Commendation Medal. He was cited for superior performance of duty while serving as an executive officer aboard the submarine USS *Springfield*. Edwards is currently assigned with the Naval Submarine Base New London in Groton, Conn. . . "I joined Silicon Graphics as a member of their technical staff in supercomputing applications," writes **Madan Venugopal**, SM '87. "I am experiencing California for the first time. I was sad to learn of Professor Frank Perkins's departure from the Graduate School. He is truly an outstanding person."

The Association of Alumni and Alumnae was notified that **Robert Arthur Hinners**, SM '32, of Damascus, Md., died on November 29, 1994, and **Otis John Earl**, SM '40, of Heathsville, Va., died on January 8, 1995. No further information was provided.

Alumni/ae may send information for Course News to <mitalum@mitvmc.mit.edu>.

GAZETTE

MIT ALUMNI JOB LISTINGS

- A bi-weekly bulletin giving employers the opportunity to reach experienced MIT graduates, and MIT graduates the opportunity to scan the market.
- If you are an employer looking for talent, or an MIT graduate looking for new directions, contact Hannah Bernstein at the address below.
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1938–1995

LES ASPIN

A Master of Defense and National Security

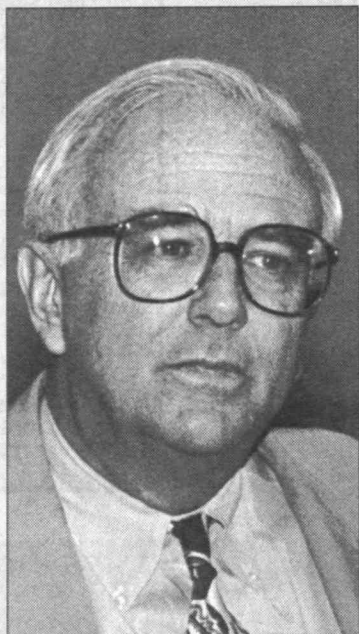
Les Aspin, PhD '66 (XIV), whose 25-year career in public service included 8 years as chairman of the Armed Services Committee and 11 tumultuous months as secretary of defense, died on Sunday, May 21, after a massive stroke. He was 56.

In a statement, President Clinton said Aspin "rendered our nation extraordinary, selfless service. No one knew better than he how Washington works, but he never thought of it as a game for its own sake. He was here to make a difference. And he did."

Aspin was born in Milwaukee in 1938. Trained as an economist, he held degrees from Yale and Oxford as well as MIT. He returned to Wisconsin in 1968, first to work for Lyndon B. Johnson's presidential campaign, then to run unsuccessfully for the Democratic nomination for state treasurer.

He taught economics at Marquette University in Milwaukee before winning election from Wisconsin's 1st Congressional District in 1970. He combined his grasp of defense issues with political skill to win election to the House for 11 additional terms. From 1971-1979, Aspin even found time to serve as a member of the MIT Corporation Visiting Committee to the Department of Political Science.

In 1985, Aspin became chair of the



Les Aspin

Armed Services Committee, and he was widely hailed for being one of the first in Washington to realize that the Cold War was largely over.

Aspin became Clinton's defense secretary at a time when the world of geopolitics was in turmoil. The Soviet empire was imploding, intense brushfires were burning in the former Yugoslavia and Somalia, and Haiti was in turmoil. U.S. social policies were also affecting the mili-

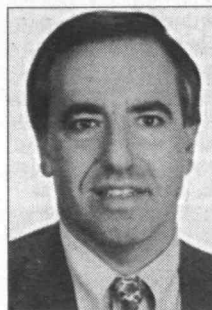
tary. Several incidents, including the death of 18 U.S. soldiers in Somalia and the retreat of a U.S. warship from Haiti when faced by a mob, led to his resignation in December 1993.

However, his service as defense secretary was not without highlights. His major achievement was to complete what he later called the "bottom-up review," a detailed assessment of defense strategy that called on the military to be prepared to fight two regional wars at once. He also brokered a compromise with Congress after lawmakers objected to Clinton's initial plan to lift the ban on gays in the military. And he broadened opportunities for women in the military by allowing them to serve in combat jobs. After Aspin's resignation, Clinton tapped him to head a bipartisan panel to review the nation's intelligence agencies. □

—Stephanie V. Grepo

XIV

ECONOMICS



J. Phillip Cooper

J. Phillip Cooper, PhD '72, reports: "I founded Road Runner Medical, Inc., in 1994 to develop and sell an integrated, software/hardware solution for mobile health care providers. With portable pen-tablet computers that are enhanced by advanced speech recognition and wireless communica-

tions to capture clinical information in the field, mobile health care providers can document patient encounters and capture data for billing, marketing, managed care, and regulatory compliance. After launching this product in the ambulance industry, I plan to target other areas of the mobile health care market, such as home-health-care nurses, physical and occupational therapists, and mobile diagnostic technicians."

Jagdish N. Bhagwati, PhD '67, the Arthur Lehman Professor of Economics and the director of the International Economics Research Center at Columbia University, was elected to the American Philosophical Society in April. Bhagwati recently accepted a position as an economic policy adviser to the director general of the General Agreement on Tariffs and Trade. International economics analysts are gathering in November to honor Bhagwati with a symposium. The American Philosophical Society, founded by Ben Franklin, is a renowned international organization that promotes excellence and useful knowledge in the sciences and humanities through scholarly research, professional meetings, publications, library resources, and community service.

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XV

MANAGEMENT

"I was appointed dean of undergraduate curriculum at Babson College in September 1994," writes Stephan J. Schiffman, '69 (XVIII), SM '83. . . . From New York City, Pankaj Vaish, '90 (XIV), SM '90, reports: "After running the swaps desk at Citibank Global Derivatives, I am now setting up a proprietary trading desk for the derivatives group." . . . Graham Copeland, MAA '78 (IV), SM '89, shares the following news: "I have taken the plunge and started a new management consulting firm, Inetix. I help companies to achieve substantially better performance in new product development. Inetix's clients have global reach and want to improve the pace at which they launch successful new products." . . . From Felton, Calif., Daniel Callahan, SM '87, writes: "We are now working on our 60th inch of rain this season. I lost four oak trees so I have lots of opportunities to vent my frustrations with my chain saw and ax." . . . Robert

A. Ellis, SM '87, updates us: "I'm now working for EMC as LSS group production manager and am responsible for \$500 million availability this quarter. My daughter, Carol, is now 7 and showing definite signs of an engineer. I'd love to hear from my classmates."

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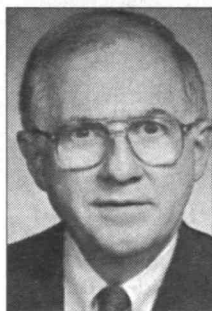
SLOAN FELLOWS

LeRoy Day, SM '60, sent the following note: "Member of the Sloan class of 1960 and their wives met for a reunion on March 26 at the Hotel del Coronado in San Diego. Twenty-seven Sloan Fellows and spouses gathered for three days of socializing, sightseeing, and golf. Those attending included: Doris and Ray Ballmer, Jim Cumberpatch, Howard Pollock, Kay and Walt Rozett, Bill De Long, Ginny and Bill Romeiser, Mary Holdsambeck, Ruth and Fred Roessle, Clinky and Cordes Seabrook, Janet Welsh, Lou Darin, Mary and Howard Kehrl, Phyllis and Ted Macklin, Margaret and Bill Stolze, and my wife, Mary Day."

Arland L. MacKinney, SM '67, writes: "I am project manager for the Nuclear Energy Institute, a member-supported trade association advocating peaceful uses of nuclear energy."

Paul A. Heinen, SM '63, of Lake Forest, Ill., died on February 26, of complications from cancer. Heinen had retired in January from GATX Corp., a major transportation and leasing company, where he had served as VP, general counsel, and secretary for 14

years. Prior to GATX Corp., Heinen had worked for Chrysler for 24 years. He had played a major role in helping sell some of Chrysler's European operation to Peugeot. . . .



A. Thomas Young

He joined Martin Marietta in 1982 as VP of Aerospace Research and Engineering after a 21-year career with NASA. At NASA, Young was director of the Goddard Space Flight Center in Maryland from 1980 to 1982. Previously he had been mission director of the Project Viking Mars landing program. For his role in this endeavor, he received NASA's highest award, the Distinguished Service Medal.

Carl Gloskey, SM '59, of Hilton Head, N.C., died on February 7. Gloskey was retired as group VP of MT Chemicals/American Can Co., responsible for internal operations in more than 25 countries. After his retirement, he formed a chemical engineering group with clients in several countries.

A. Thomas Young, SM '72, executive VP of Lockheed Martin Corp., was elected to the Potomac Electric Power Co.'s board of directors. Prior to the merger of Martin Marietta Corp. and Lockheed Corp. earlier this year, Young had been president and COO of Martin Marietta since January 1990.

CourseNews

He lectured at the University of Moscow, and directed research at Monash University in Melbourne, Australia, and the New South Wales Institute of Technology in Sydney. During World War II, Gloskey was a navigator with the 8th Air Force in Europe and was awarded the Purple Heart and two Bronze Stars. He also served in Cuba in submarine detection and with the Air Transport Command. He was a member of the American Chemical Society and the American Institute of Chemical Engineers.

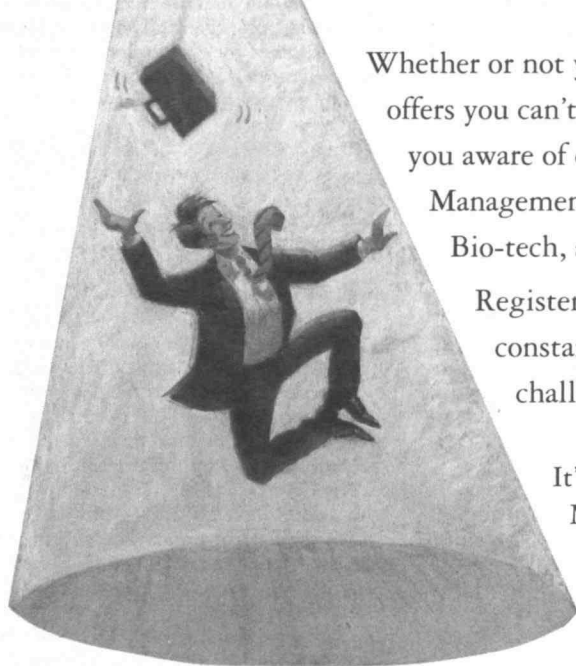
Carl Frederick Franz, SM '52, of Indianapolis, Ind., died on July 17, 1994. He was VP and general manager of Schwitzer Division of Wallace Murray Corp., retiring in 1970. Previously, he had been a manager at Ford. He also held degrees from Wayne State University and Harvard Business School.

The Association of Alumni and Alumnae was notified that Judith Helen Carey, SM '79, of Quincy, Mass., died of a brain tumor on May 5, 1994; John Christy Davis, SM '56, of Colorado Springs, Colo., died on January 5, 1995; and Carl Anthony Odening, '54, of Wallingford, Pa., died on February 27, 1995. No further details were provided.

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MANAGEMENT OF TECHNOLOGY

Jon Otterstatter, SM '92, is the VP for development at ShowCase Corp., which makes client-server products for Window's-based AS400 systems. Otterstatter also told us that Brian Truskowski, SM '89, is now the director of Systems Development for IBM in Rochester, N.Y. . . . Julio Freire, SM '94, and his wife, Monica, announce the birth on April 26 of their third child, Raymundo Freire.

B. Joseph Pine, SM '91, recently visited the MOT Program Office to catch up and tell us that he published an article in the Harvard Business Review entitled "Do You Want to Keep Your Customer Forever?" . . . Edward Obbard, SM '92, is working at Pacific Monolithics, a small wireless communications company in Sunnyvale, Calif., where he is planning to launch a new product line. Since the company sells their products overseas, he tells his classmates to "Get those guest beds ready!"—Send news via e-mail at <mitmot@sloan.mit.edu> or write to Management of Technology Program, MIT, 50 Memorial Drive, Suite E52-126, Cambridge, MA 02142.

XVI AERONAUTICS AND ASTRONAUTICS

A tempting note from William A. Sangster, SM '37, of Victoria, British Columbia: "I extend a standing invitation to any of my classmates who visit our fair city to go for a sail. A few days notice would be appreciated, but it is not essential. I go sailing at the drop of a hat. I would also welcome letters or calls from any of classmates."

Thomas W. Laming, SM '84, updates us with the following news: "For the past two years, I have been a portfolio manager and VP of Kornitzer Capital Management in Kansas City. I make my home in Leawood, Kans., with my wife, Jennifer, and our son, Tommy."

Edward Moscovitch, PhD '66, of Gloucester, Mass., reports: "My book *Special Education—Good Intentions Gone Awry* was published by the Pioneer Institute in the spring of 1994. The May 1994 issue of *Electricity Journal* published an article of mine on demand-side management."

Roland J. Boucher, SM '39, of Underhill, Vt., died on April 21, 1995. Boucher, a longtime radio and television meteorologist and a pioneer in weather research, died after complications related to cancer. He was best known as one of the first American Meteorological Society-certified meteorologists on Boston television and as a fixture on the radio dial where his daily forecast was heard on Framingham's WKOX for more than 35 years. Boucher was involved in projects that ranged from the first weather satellite to forecasting techniques using Doppler Radar to the very latest radar development, NexRad. He began his career in 1939 with the newly organized Pan American Airways as a meteorologist and forecaster for transoceanic and overseas operations. He served on the Weather Modification Advisory Committee to President

Dwight D. Eisenhower, and, during World War II, he supervised a statistical study of 40 years of weather history data that provided the basis for long-range forecasting during and after the war. From 1944 to 1949, he served as district forecaster for the U.S. Weather Bureau Forecast Office in Boston. He conducted research in the physics of weather for Harvard University, Mount Washington Observatory, Blue Hill Observatory, and the Air Force at the Air Force Cambridge Research Laboratory. An accomplished photographer of weather phenomena, Boucher had his work published in *Time* magazine, weather textbooks, and encyclopedias. In 1986, he retired to Underhill Center in Vermont with his home at the foot of Mount Mansfield, where he was active with mountaineering and cross-country skiing groups. He climbed the 100 highest mountains in New England.

The Association of Alumni and Alumnae was notified that Philip Lyman Brewster, SM '63, of Henderson, Nev., died on November 4, 1994, and Allen B. Thompson, SM '50, of Dallas, Tex., died on November 7, 1994. No further information was provided.

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XVII POLITICAL SCIENCE

Congratulations to Marc E. Norman, SM '89, who writes: "I received my PhD in energy management and environmental policy from the University of Pennsylvania in December 1994. I am now an environmental policy research consultant in Washington, D.C."

From Tokyo, Stephen J. Anderson, SM '83, PhD '87, writes: "I am a research professor at the Center for Global Communications, a leading institute that is affiliated with the International University of Japan. The institute is focused on information infrastructure and the Internet in Japan. I had taught in Wisconsin and Virginia before joining the center."

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XVIII MATHEMATICS

"I'm a professor of computer science at the University of Texas/Austin, still working in artificial intelligence," writes Benjamin Kuipers, PhD '77. "MIT Press published my book on qualitative reasoning." . . . We received some biographical information on A. Ben Clymer, SM '48, of Hessel, Mich., who died on July 20, 1994. He was a pioneer in the field of simulation working on mechanical analog computers for 5-inch guns in 1942-45. As chairman of Mission Earth for the Society of Computer Simulation in recent years, Clymer was dedicated to bringing scientists together to explore the roles of world simulation as a tool for global planning.

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XX APPLIED BIOLOGICAL SCIENCES

"Shirley and I are headed for St. Petersburg, Russia, with the International Executive Service Corps for one month, after which I hope to be more fully retired," writes **Harmon L. Liebman**, SM '54, of Holtwood, Pa.

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XXI HUMANITIES

Elting Morison, former MIT professor of humanities, died on April 20. Morison chronicled the lives of American military leaders in his biographies. His first book was *Admiral Sims and the Modern American Navy*, for which he won the J.H. Dunning Prize. He also wrote an industrial history entitled *From Know-How to Nowhere: The Development of American Technology*, and edited an eight-volume series, *Letters of Theodore Roosevelt*. After serving in the Naval Reserve during World War II, Morison joined the MIT faculty. In a speech at MIT in September 1963, Morison said he believed that universities were the only hope to bring people and technology into sync. "Universities can do it," he said, "but they must first reorganize themselves by allowing artists and scientists to mingle." Today's scientific world can only deal with human

needs, he said, when poets and scientists can meet with mutual understanding. After 20 years here, he moved to Yale University, where he taught history. He described himself as on a campaign to "rescue history from becoming a dead language." He said, "It is not so important what happened, but how it happened." After his retirement from Yale, he returned briefly to MIT as Killian Professor Emeritus of Humanities.

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TPP TECHNOLOGY AND POLICY PROGRAM

Clinton Andrews, SM '85, PhD '90 (XI), edited *Regulating Regional Power Systems*, with contributions from **Stephen Connors**, SM '89, and **Richard Tabors**, senior research engineer at MIT, and *Industrial Ecology and Global Change* with contributions from **Robert Chen**, '76, SM '82 (TPP and XIX). Andrews is the director of interdisciplinary research at the Consortium for International Earth Science Information Network in Saginaw, Mich. . . . **Lissa Perlman** and **Seth Hulkower**, SM '86, are delighted to announce the birth of their first child, **Talia Minna Hulkower**, on June 20, 1994. In July 1994, they purchased a home in Manhattan, and in the following December, they completed the renovations and moved in. Hulkower joined **Merrill International, Ltd.**, as a VP. **Merrill International** is an energy project development firm specializing in elec-

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tric power projects worldwide, and employing technologies ranging from wind turbines to fluidized circulating bed coal boilers (but no nuclear plants).

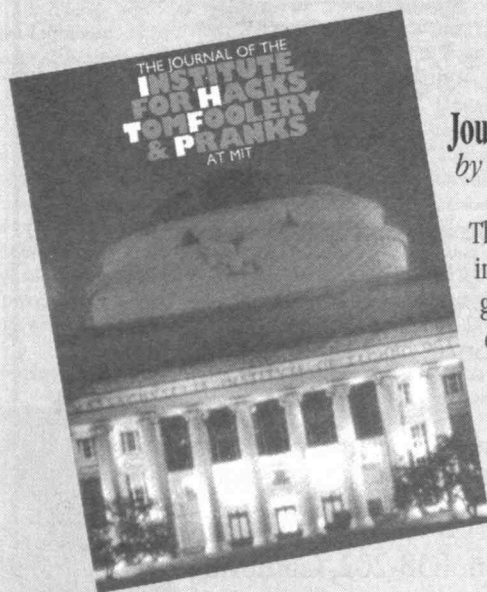
Jaime Maldonado, SM '90, has been promoted to principal at Booz-Allen, with responsibilities for developing an infrastructure practice in Colombia, Venezuela, and Ecuador. He is engaged to be married. . . . **Brian Schenck**, SM '94, has joined the staff at Intel in New Mexico. . . . **Kory Sylvester**, SM '94, has celebrated one year of wedded bliss!—**Richard de Neufville**, TPP, MIT Room E40-252, Cambridge, MA 02139; e-mail: <tpp@mit.edu>

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

Edwin Delamater Ryer, '20; March 9, 1995; Duxbury, Mass.
George Dateo, '21; September 4, 1994; W. Roxbury, Mass.
Oliver Edwin Williams, '21; April 2, 1995; Charlotte, N.C.
Bertha S. Wiener Dodge, SM '22; March 5, 1995; Burlington, Vt.
John Skelton Williams, '22; March 31, 1995; Richmond, Va.

Hack \hak\ *n* 1: A prank, usually elaborate. *v* 1: To perform a prank.
 2: To explore the places on campus that are not usually accessible. 3: To work at or study a subject not especially for academic gain.



Journal of the Institute for Hacks, Tomfoolery, & Pranks at MIT by Brian M. Leibowitz

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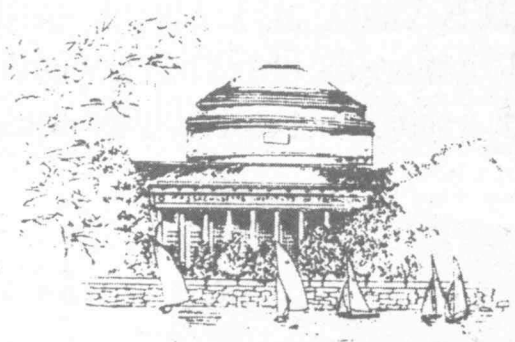
Edward Hume Clendenin, '23; October 17, 1993; Plainfield, N.J.
 Russell Austin Cowles, SM '25; November 21, 1994; Birmingham, Mich.
 Francis Edward Anderson, '27; September 5, 1994; Needham, Mass.
 Francis Joseph Guscio, '27; March 15, 1995; Tucker, Ga.
 John William Johnson, '28; December 21, 1993; Lake Worth, Fla.
 Walter Ullrich, SM '28, ScD '36; March 25, 1995; Pleasantville, N.Y.
 Levin Wilson Foster, SM '30; December 12, 1992; Coose Creek, S.C.
 Albert Foard Coleman, '31; March 4, 1995; Daytona Beach, Fla.
 William Vogt Kaeser, SM '32; April 13, 1995; Madison, Wisc.
 John Tremain Kelton, '32; March 4, 1995; Essex, Conn.
 Charles Harold Pierce, '32; December 23, 1994; South Yarmouth, Mass.
 Winthrop Field Conant, '33; April 5, 1995; Manchester, Conn.
 Thomas Kevin Fitzpatrick, '33; February 22, 1995
 Lewis William Moore, '33; March 20, 1995; San Diego, Calif.
 Elmer Otis Waterman, '33; July 11, 1994; Medford, Mass.
 Jacob Howard Beck, '35; April 18, 1995; Waban, Mass.
 William Lacy Root, '35; July 27, 1994; Yarmouth, Maine
 Robert Hector Boden, SM '34, PhD '36; February 2, 1995; Sedona, Ariz.
 James Lawrence, '36; January 29, 1995;

Brookline, Mass.
 Harold Thomas Smyth, PhD '36; November 24, 1994; E. Brunswick, N.J.
 Winthrop Asa Johns, '37; April 23, 1995; No. Palm Beach, Fla.
 Joseph Morgan, PhD '37; April 30, 1994; Oakton, Va.
 Peter Okawa Iwatsu, '38; February 6, 1995; New York, N.Y.
 David Leopold Morse, '38; March 29, 1995; Newton, Mass.
 Roland John Boucher, SM '39; April 21, 1995; Underhill Center, Vt.
 Robert Green Hall, '40; June 10, 1994; Huntsville, Ala.
 Jack Meriwether Klyce, '41; December 26, 1994; Bellbrook, Ohio
 Sutton Monro, '42; March 5, 1995; S. Burlington, Vt.
 Leonard Stuart Croan, '43; May 23, 1994; Alexandria, Va.
 James Willans Davisson, PhD '43; February 4, 1995; Oxon Hill, Md.
 Alexander Martin Smith, ScD '43; March 31, 1995; Elkin, N.C.
 Edward Peter Wyruchowski, '47; December 9, 1994; Bainbridge Island, Wash.
 Godfrey Thomas Coate, '47; January 30, 1995; Belmont, Mass.
 James Joseph Hennessey, '47; February 17, 1995; Louisville, Ky.
 Grant Umberger, '47; June 27, 1994; Gainesville, Ga.
 George Philip Haviland, '49, SM '50; December 8, 1994; Prescott, Ariz.
 Harvey Eugene Lyon, '49; March 27, 1995; Fairfax, Va.

William Alfred Streat, SM '49; February 6, 1994; Greensboro, N.C.
 Marc George Dreyfus, '50; February 4, 1995; Fairfield, Conn.
 Louis Mager, '50; March 22, 1995; Chestnut Hill, Mass.
 Ronald James Rabalais, '50; May 25, 1993; Williamsburg, Va.
 Norman Noel Alperin, SM '56; May 26, 1994; Rancho Palos Verdes, Calif.
 John Christy Davis, SM '56; January 5, 1995; Colorado Springs, Colo.
 George Bruce Brown, SM '59; October 13, 1994; Dorval, Quebec, Canada
 David Charles Hill, SM '59; September 18, 1994; Attleboro, Mass.
 David Lincoln Morse, '59, SM '61, ScD '64; October 29, 1994; Ithaca, N.Y.
 John Warren Rainey, '59; March 15, 1995; Fitchburg, Mass.
 Philip Lyman Brewster, SM '63; November 4, 1994; Henderson, Nev.
 Joseph Albert Coldwell, '64; April 9, 1994; Tulsa, Okla.
 Robert Ralph Ebert, '72; April 11, 1995; Cambridge, Mass.
 Philip Richard Kauffman, '82; April 24, 1994; Seattle, Wash.
 Steven Scott Carroll, '84; April 24, 1995; South Hampton, N.H.
 Julia Lynne White, '87; August 9, 1994
 Peter Farnsworth Grasty, SM '91; April 5, 1994, San Francisco, Calif.
 Antonio Thomas Pizzigati, '92; April 27, 1995
 Martin Richard Friedmann, SM '93; February 1, 1995, Chicago, Ill.



HERE MIGHT A NAME BEST LIVE?



The name of a deceased MIT alumna or alumnus can be linked to the Institute through gifts made by classmates, colleagues and family. Memorial gifts can be unrestricted or directed toward scholarships, research or any program of the Institute. The Institute notifies bereaved families of the name of each donor, and each gift becomes a part of MIT's permanent record.

Named endowed funds whose income supports the work of the Institute in perpetuity can be established with larger gifts. If you would like information on ways of expressing sympathy through a memorial contribution, or on establishing a named endowment fund, please contact Betsy Millard, MIT Room E38-202, Cambridge, MA 02139 or call (617) 253-8059.

PuzzleCorner

I am attending a conference in Italy in June (today is 23 May) and have decided to pursue an almost un-American activity: I am trying to learn a little of the language. I must confess that in high school, I had some Italian and French so I was not 100 percent ignorant of the language, but I was close. Anyway I have some tapes, which I listen to in the car, while walking from the train to work, and while doing some home repairs. It is actually a little fun. So far I recommend it, but the real test comes next month.

I have received a subscription to *The Cryptogram* from Puzzle Corner contributor Rick Hedrick. Readers interested in the subject should contact the American Cryptogram Association, One Pidgeon Dr., Wilbraham MA 01095-2603.

Problems

A/S 1. We start with a Bridge problem from Doug Van Patter that occurred during an ACBL (country-wide) charity event.

North	
♠	Q J 10 6 5
♥	A J 10 7
♦	Q 7 5
♣	3
West	
♠	2
♥	Q 9 6 5 4 3
♦	10 6 4 3
♣	9 5
East	
♠	9 7 4 3
♥	2
♦	A J 2
♣	K 10 7 6 4
South	
♠	A K 3
♥	K 8
♦	K 9 8
♣	A Q J 8 2

Your partner opens a skinny one spade. After discovering that one ace is missing, you bid six no trump (trying to protect heart king). Opening heart lead is taken

by dummy's ten. The jack of clubs is finessed and the heart king cashed. A low diamond to queen is taken by East's ace, who returns a spade. Can you now make your unlikely contract?

A/S 2. Don "Hoppy" Hopkins has an arithmetical crossword puzzle for us. He often gives out the answer to 7 across as a hint since it is easy to look up, but takes time. If you wish to have this hint see the end of the column.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
11.				12.			13.		
14.			15.			16.			
17.			18.		19.		20.		
21.	22.	23.				24.		25.	
26.				27.			28.		
29.			30.			31.			
32.				33.					

ACROSS

- A multiple of this number is obtained by removing the first digit and placing it after the last digit.
- The year in the 20th century when Easter is earliest.
- Divisible by 7, 11, and 13.
- Multiple of 30 Down.
- When added to 16 Across is equal to the sum of 23 Down and 25 Down.
- See 26 Across.
- A multiple of 9.
- See 13 Across.
- This number has the same first and last digits.
- A multiple of 3.
- Ten times 31 Across plus five times 13 Across.
- Factorial 9.
- Multiple of 28 Across.
- Sum of 3 Down and 14 Across.
- See 8 Down.
- See 24 Across.

A/S 3. Rick Hendrik wonders, given a regular dodecahedron (12 pentagonal faces) with an edge length of 10, what is the largest regular icosahedron (20 triangular faces) that will fit inside?

Speed Department

Consider the nondecreasing infinite integer sequence (1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 7, ...), in which the integer i occurs

exactly i times. Using your favorite programming language, write a one-line program without loops to display the n th term (you may use n in your answer).

Solutions

APR 1. Winslow Hartford sends us the following Sheinwold problem in which South is declarer at 6 hearts and is to make the contract against a lead of the D7.

29. See 4 Down.

31. See 19 Across.

32. Equal to 22 Down.

33. $105 \times \pi$ to the nearest integer.

DOWN

- The cube of a prime number.
- A multiple of 17 Across.
- A multiple of 7.
- Sum of twice 21 Across and 29 Across
- See 10 Down.
- This number is equal to the sum of the cubes of its digits.
- A cube number.
- The sum of 15 Across and 27 Down.
- See 20 Down.
- A multiple of 5 Down.
- A square number.
- Ten times 9 Down plus 1.
- Equal to 32 Across.
- See 13 Across.
- See 13 Across.
- Factor of 12 Across.



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO: ALLAN GOTTLIEB
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715 BROADWAY, 10TH FLOOR
NEW YORK, N.Y. 10012,
OR TO: GOTTLIEB@NYU.EDU

		North			
		♠	Q 10 8 6 3 2		
		♥	A J 4		
		♦	4 2		
		♣	Q 7		
West				East	
♠	9 7 4			♠	K 5
♥	8 7 6 5			♥	None
♦	7			♦	K J 9 6 5 3
♣	K 6 4 3 2			♣	A J 10 9 8
		South			
		♠	A J		
		♥	K Q 10 9 3 2		
		♦	A Q 10 8		
		♣	5		

The following solution is from J. Keilin:

South wins the diamond lead as cheaply as possible and plays to North's heart A. This is followed by a low spade to the South hand, again winning as cheaply as possible. South plays the remaining spade and plays to North's heart J. The spade Q is played on which a low diamond is tossed. That is the first key play. North's last trump is lead to the South hand and all remaining trumps are played. Dummy holds on to two clubs and a spade. This is the second key play. At this point South has won 10 tricks: 1 diamond, 3 spades, and 6 hearts. On the last trump, East is squeezed. If he keeps no more than one club, South plays the club 5. If West wins he must return a club to North's queen and the board is good. If East wins, he must lead away from his diamonds and South takes the last two diamonds.

APR 2. Nebraska was just named the national champion in college football, bringing great cheer to Lincoln but much sadness to State College. Jerry Grossman, asks us to show that round-robin tournaments always have at least one player "transitively better" than everyone else. Specifically, Grossman writes:

A round-robin tournament was held among n players, each player playing one game against every other player. No game ended in a tie. Show that there exists a player K such that for every other player L , either K beat L , or K beat someone who beat L .

Jack Bross sent us a (nondeterministic) algorithm together with a proof by induction.

The basic strategy for finding a team that is "transitively better" than all other teams is actually pretty simple. Pick a team (A) and check to see if it is transitively better than all other teams. If not, then there is a team B which not only defeated A, but defeated every team which A beat. Test to see if B is transitively better. If not, there is a team C (etc). Eventually, you run out of teams, and hit one that is transitively better than all other teams. Note that there may be more than one such team, so this doesn't actually "decide" any championship, necessarily. To prove that this works, we need

a proof by induction (sigh).

Let $S(0)$ be the set of all teams, and $x(0)$ a randomly selected starting team. If $x(0)$ isn't the team we're looking for, then let $S(1)$ be the set of all teams which beat $x(0)$ and which beat every team that $x(0)$ defeated. Let $x(1)$ be an element of $S(1)$. Now keep going, defining $S(n+1)$ to be the set of all teams which beat $x(n)$ and which beat every team that $x(n)$ defeated. Again, pick $x(n+1)$ in $S(n+1)$. Claim: $S(n+1)$ is a subset of $S(n)$: If y is in $S(n+1)$, then it defeated every team that $x(n)$ defeated. But $x(n)$ defeated $x(n-1)$, so y defeated $x(n-1)$. Also, if $x(n-1)$ defeated a team z , then $x(n)$ defeated z . But then y defeated z , since it defeated every team that $x(n)$ beat. So y is by definition in $S(n)$.

Basically, this means that each set $S(n)$ is contained in the previous set. You "throw out" at least one element every recursive step (because you throw out the $x(n)$'s). $S(0)$ is finite. Therefore, the process has to stop sooner or later. In order for the process to stop, one of your $x(n)$'s has to be transitively better than any other team.

APR 3. Robert Moeser has one that he suggests you solve by hand for $N \leq 5$, but use a computer if you want to try larger N . Use N identical cubes and create a solid object by joining them only by gluing a face against another face such that the two faces are in perfect alignment. Consider that two such objects are identical if one can be rotated and placed in exact correspondence with the other. (Objects that are mirror images, however, are considered different.)

How many different objects can be made with $N = 1, 2, 3, 4, \dots$ cubes?

Winslow Hartford reports that in the December '89 issue of *World Game Review* the first 8 answers are 1, 1, 2, 8, 29, 166, 1023, and 6922. Ken Rosato sent us the pictures shown below for the first four cases and Matthew Fountain used diagrams (also shown below) for the first five cases. Fountain writes:

There is 1 object formed when $N=1$ or $N=2$. There are 2 when $N=3$, 8 when $N=4$, and 29 when $N=5$. To find these objects I drew diagrams in which lines joined the center of blocks glued together. To avoid too many diagrams, I drew diagrams representing $N-1$ blocks in heavy lines and then drew light lines representing where the N th block could be added to form an object not duplicating any previously considered. The lines connected the centers of the blocks. I investigated all possible different arrangements for $N-1$ blocks as starting points. (Please see Figures 1 and 2 at right.)

Better Late Than Never

F/M SD. Frank Rubin notes that a "Scrabble" word (i.e., one in the *Official Scrabble Players Dictionary*) PARADROP has more letters than BARBARA, all from the allowed set.

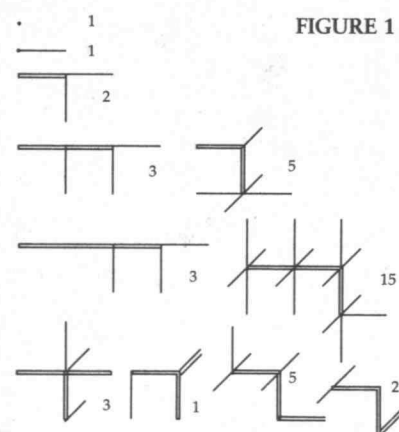


FIGURE 1

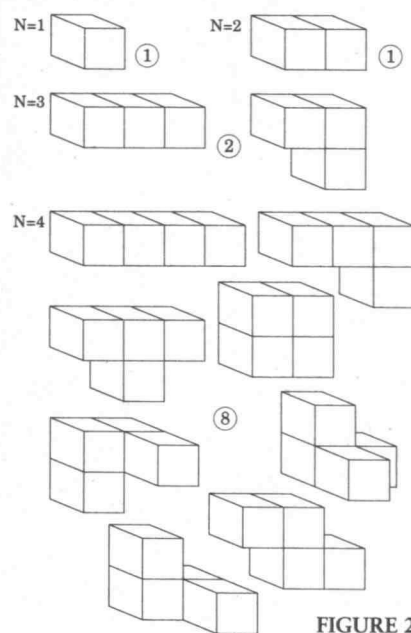


FIGURE 2

APR SD. Frank Rubin and Joshua Abraham noted that you can move matchstick(s) to convert the leftmost triangle to N and then read the middle triangle as O . This gives NO "triangle."

Other Responders

Responses have also been received from W. Cluett, R. Freedman, H. Gilinson, J. Grossman, E. Lund, A. Ornstein, R. Price, E. Rose, L. Schaidler, L. Steffens, A. Ucko, M. VanPatter, and G. Zartarian.

Proposer's Solution To Speed Problem

In Basic, PRINT INT(SQR(ABS(2*n%)) + 1/2)

The hint for A/S 2 is 1913.

MIT LIFE INCOME FUNDS

MRS. DOROTHY BRYAN WILLIAMS

HOME: Providence, Rhode Island

CAREER: In 1939, shortly after graduating from the University of Illinois, Dorothy Williams married Glenn C. Williams. He had just earned his master's degree in chemical engineering there and was coming to MIT for a doctorate. Although they intended to return to Illinois, the Williams liked MIT so much that in 1942, when Glenn was offered a faculty appointment, they decided to stay. He became a world authority on combustion, leading MIT's Torpedo Fuel Lab during World War II, and later the MIT Fuels Research Laboratory. Dorothy earned a master's in early childhood education at Tufts, taught and served as a student teacher supervisor, and became a nursery school director in Lexington, Massachusetts. She left that position when her husband went on sabbatical, and took a job with the publisher D.C. Heath when they returned.

Retiring in 1982, Dorothy became more active with the MIT Women's League, serving on its board and as chair of the Honorary Matrons after her husband's death in 1991.

Until recently, Dorothy lived in a Lexington retirement community, working on its Greenhouse Committee to keep its gardens in bloom. She recently moved to Providence to be near her daughter and family. She also has a son who lives in Arkansas.

MIT LIFE INCOME FUND: The Dorothy B. Williams Fund in the William Barton Rogers Pooled Income Fund.

QUOTE: I have enjoyed all my years with MIT, serving on the board of the Eastgate and Westgate nursery schools, helping with the bloodmobile, and working with other faculty wives. Glenn was deeply interested in graduate education, so we also always had many graduate students visiting our home. To me, MIT has always been like family.

For more information about MIT Life Income Funds, write or call D. Hugh Darden, W. Kevin Larkin or Frank H. McGrory at MIT, Room 4-234, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139-4307, (617) 253-3827.

Photo: Richard Howard



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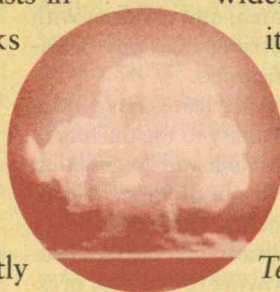


ILLUSTRATIONS: SUSAN LEVAN

THE Atomic Age^{AT} 50

This August 6 and 9 mark the fiftieth anniversary of an awesome pair of events—the dropping of atomic bombs by the United States on the Japanese cities of Hiroshima and Nagasaki. The second and third such devices ever built—the first was successfully tested by Manhattan Project scientists in New Mexico just three weeks before—they were the only atomic weapons ever actually used in war, and they provided a dramatic finish to the ordeal of World War II.

Although these devices abruptly ended one era, they simultaneously ushered in another—this one seemingly without end—humankind in sudden and irreversible possession of the most potent technological force ever seen on earth. For most of the past 50 years such knowledge has been used to drive a veritable “population explosion” of nuclear weapons, all of them far more sophisticated and destructive than their relatively modest but nevertheless city-destroying ancestors of 1945, a tide that has only lately begun to recede.



The “golden anniversary” of Hiroshima and Nagasaki thus begs for reflection, analysis, and the formulation of lessons learned and policy recommendations, not only regarding the events at Hiroshima and Nagasaki themselves but the nuclear arms race they helped precipitate, its wider ramifications, and prospects for its future.

In that spirit, and because of its fundamental relevance to our beat of “technology and its implications,” the editors of *Technology Review* invited a variety of scientists, technologists, historians, policymakers, and informed and motivated citizens to set down some of their thoughts, prompted by the August commemorations, in a Special Issue for the magazine’s readers. We have grouped the seventeen essays that follow, which cover a diverse set of subjects and include a range of viewpoints, into four subsets: “Recalling the Original Events,” “Facing a Difficult Legacy,” “Weighing the Value of Nuclear Weapons,” and “Ending the Reign of Terror.”

Hiroshima, Nagasaki, and the Politics of Memory

The notion that dropping the atomic bombs was simply a brutal necessity for swiftly ending the war continues to dominate the American psyche—despite facts and perspectives to the contrary.

JOHN W. DOWER

FIFTIETH anniversaries of historical events—particularly wars—breed controversy. The emotion-laden memories of survivors from the events of a half-century ago collide with the skepticism and detachment of younger generations. Historians with access to previously inaccessible (or ignored) material offer new perspectives. Politicians milk the still palpable human connection between past and present for every possible drop of ideological elixir.

The fiftieth anniversary of the end of World War II in Asia has become especially contentious. Why is this so, when presumably we are commemorating victory over an enemy generally regarded as aggressive, atrocious, and fanatical? The answer, of course, is that defeating Japan ultimately entailed incinerating and irradiating tens of thousands of men, women, and children with a weapon more terrible than any previously known or imagined.

Unfortunately, Americans have been denied a rare opportunity to use the fiftieth anniversary of Hiroshima and Nagasaki to reflect more deeply about these world-changing developments. This opportunity was lost early this year when the Smithsonian Institution, bowing to political pressure, agreed to drastically scale back a proposed exhibit at the National Air and Space Museum in Washington depicting the development of the atomic bombs and their use against Japan.

As initially envisioned by the Smithsonian's curators, the exhibition would have taken viewers through a succession of rooms that introduced, in turn, the ferocity of the last year of the war in Asia, the development of the bomb, the unfolding imperatives behind the U.S. decision to use the weapon against Japan, preparation for the *Enola Gay* mission that dropped the first bomb on Hiroshima (with the fuselage of the *Enola*

Gay itself being the centerpiece of the exhibition), the human consequences of the bombs in the two target cities, and the nuclear legacy to the postwar world. Occasional placards were to have summarized controversies that have emerged in scholarship and public discourse on these matters over the past decades.



This ambitious proposed exhibit proved to be politically unacceptable. The Senate unanimously denounced the original draft script as being "revisionist and offensive to many World War II veterans." It was grossly misleading and morally obtuse, the critics declared, to focus the exhibit so intensely on questions about the bombs, and on the Japanese

suffering in Hiroshima and Nagasaki, without comparable portrayal of Japanese atrocities that extended from Nanking to Pearl Harbor to Bataan to Manila. The chief historian of the Air Force (who had privately praised the original draft) asked publicly how the Smithsonian had managed to make a hash of such a "morally unambiguous" subject as the use of the bombs.

Confronted by such criticism, the Smithsonian—like Japan 50 years earlier—surrendered unconditionally. Visitors to the Air and Space Museum will encounter a small exhibition featuring the fuselage of the *Enola Gay* and a brief tape and text explaining that this was the plane that dropped the first atomic bomb, following which, nine days later, Japan surrendered. The artifact, it is now argued, speaks for itself.

Artifacts do not speak for themselves, and the decision to scrap original plans for an ambitious and nuanced exhibition represents the triumph of patriotic orthodoxy over serious historical reflection and reconstruction. No one denies that the Smithsonian's original script had problems and needed revisions (the curators themselves readily circulated their first draft for critical comments). The benign and minimalist exhibit we have ended up with, however, is a travesty—an appallingly simplistic and nationalistic way of representing one of the most momentous and destructive developments of the twentieth century. Instead of using the fiftieth anniversary of Hiroshima and Nagasaki to reflect on the confluence of triumph and tragedy that occurred in August 1945, we have turned this into another occasion to perpetuate a heroic national myth.

Questioning the "Heroic Narrative"

The orthodox account argues that the war in Asia was a brutal struggle against a fanatical, expansionist foe (which is true, albeit cavalier about European and American colonial control in Asia up to 1941). This righteous war against Japanese aggression was ended,

TOP-LEVEL POLICY-MAKERS ALSO HAD POSTWAR POLITICS, BOTH GLOBAL AND DOMESTIC, ON THEIR MINDS. FOR EXAMPLE, THEY HOPED THAT THE BOMB WOULD DISSUADE STALIN FROM PURSUING SOVIET EXPANSION.

the heroic narrative continues, by the dropping of the atomic bombs, which saved enormous numbers of American lives that otherwise would have been sacrificed in the invasion of Japan that was deemed necessary to force a surrender. As the Senate's condemnation of the Smithsonian's plans put it, the atomic bombs brought the war to a "merciful" end.

President Truman and his advisers clearly did consider the bombs as a way of hastening the war's end and saving American lives. Few historians, however, now regard this as the only motivation behind the decision. Facts that complicate the orthodox narrative, for example, include the Soviet entry into the war against Japan on August 8, 1945, two days after Hiroshima. Most Japanese accounts then and since weigh the Soviet declaration of war as being at least as shocking as the Hiroshima bombing to the Japanese leadership. The United States had long solicited Soviet entry into the war against Japan, and knew it was imminent. Why the haste to drop the bomb before the effect of the Soviet declaration of war could be measured?

The heroic narrative similarly fails to question the need for the atomic bombing of Nagasaki on August 9, which occurred before Japan's high command had a chance to assess Hiroshima and the Soviet entry. Indeed, even many Japanese who now accept that Hiroshima may have been necessary to crack the no-surrender policy of Japanese militarists maintain that Nagasaki was plainly and simply a war crime.

Also generally neglected in the heroic narrative is that the United States was not on the brink of invading Japan in August of 1945. The preliminary assault, aimed at the southern island of Kyushu, was slated for no earlier than November 1, and the invasion of Tokyo and the Kanto area on the main island of Honshu would not have commenced until March 1946. There was time to consider options. Other information suggests that an invasion may not have been necessary at all. A famous report by the U.S. Strategic Bombing Survey, published in 1946, concluded that Japan was so materially and psychologically weakened by August 1945 that it would have been forced to surrender by year's end, and probably by November 1—without the atomic bombs, without the Soviet entry, and without an invasion.

Alternatives to using the atomic bombs on civilian targets also became known after Japan's surrender. Navy planners, for example, believed that intensified economic strangulation would bring Japan to its knees; the country's merchant marine had been sunk by 1945. Within the Manhattan Project, the possibility of dropping the bomb on a "demonstration" target, with Japanese observers present, had been broached but rejected—partly for fear that the demonstration bomb might be a dud and would lead the Japanese to fight even more ferociously. Conservative officials such as Undersecretary of State Joseph Grew, the former ambassador to Japan, argued that the Japanese could be persuaded to surrender if the United States abandoned its policy of demanding unconditional surrender and guaranteed that the emperor would be

allowed to keep his throne. Through their code-breaking operations, the Americans also were aware that, beginning in mid-June, the Japanese had made vague overtures to the Soviet Union concerning negotiating an end to the war.

A Complex Question of "Why?"

While it was fear of a Nazi bomb that originally propelled the Manhattan Project, it now is known that U.S. planners had identified Japan as the prime target for the atomic bomb as early as 1943—a year or more before it became clear that Germany was not attempting to build such a weapon. One reason for this shift of target was the fear that if the bomb didn't work, sophisticated German scientists and engineers might be able to disassemble it and figure out how to build their own. (No one worried that the Japanese had this capability.)

The development and deployment of the bombs also became driven by almost irresistible technological and scientific imperatives. J. Robert Oppenheimer spoke for many of his brilliant colleagues on the Manhattan Project when he later acknowledged how "technically sweet" the enterprise had been. Oppenheimer also confided that after Germany's surrender on May 8, 1945, he and his fellow scientists intensified their efforts out of concern that the war might end before they could finish. Secretary of War Henry Stimson, the elder statesman who took deep pride in his moralism, observed at one point that it was essential to try the new weapon out on a real target. The original justification for moving to a new order of destructive weaponry had evaporated, and the weaponry itself had begun to create its own rationale.

Sheer visceral hatred abetted the targeting of Japan for nuclear destruction. Although many critics of the Smithsonian's original plans took umbrage at a statement calling attention to the element of vengeance in the American war against Japan, few historians (or honest participants) would discount that this was a factor. Japan had, after all, attacked the United States. "Remember Pearl Harbor—Keep 'em Dying" was a popular military slogan from the outset of the war, and among commentators and war correspondents at the time it was a commonplace that the racially and culturally alien Japanese were vastly more despised than their German allies.

U.S. leaders also had postwar politics on their minds—both global and domestic. Documents declassified since the 1960s make unmistakably clear that from the spring of 1945, top-level policymakers hoped



The Japanese now estimate that within months of the attacks, around 140,000 people probably died in Hiroshima and 70,000 in Nagasaki.



that the bomb would dissuade Stalin from pursuing Soviet expansion into Eastern Europe and elsewhere. Some individuals closely involved with the development of the bomb (such as Arthur Compton, Edward Teller, and James Conant) further argued that the new weapon's very horrendousness compelled its use against a real city, so that the postwar world would understand the need to cooperate on arms control. At the same time, shrewd readers of the domestic political winds in the United States warned that if the

Manhattan Project ended

with nothing dramatic to show for its efforts, the postwar Congress surely would launch a hostile investigation into the huge disbursement of secret funds.

Some maintain that Japan was so weakened by August 1945 it would have been forced to surrender by year's end—without the atomic bombs and without an invasion.

The Calculus of Casualties

The Japanese now estimate that within months of the attacks, around 140,000 people probably died in Hiroshima and 70,000 in Nagasaki. That is about double the figures typically reported in Western accounts, which are based on U.S. calculations made shortly after the bombs were dropped.

Such figures fail to take into account the peculiar long-term legacies of nuclear devastation. Because of the uncertain genetic effects of radiation poisoning, for example, *hibakusha*, as the atomic bomb survivors are known, became undesirable marriage prospects. And although no genetic harm to succeeding generations has been identified, irradiated survivors and their progeny have lived with gnawing fear that the curse of the bombs may be transgenerational. In the Japanese idiom, many survivors suffer “keloids of the heart” and “leukemia of the spirit.”

More concretely, Japanese continue to die of atomic-bomb related diseases. Survivors suffer higher-than-normal rates of leukemia and cancers of the thyroid, breast, lung, stomach, and salivary glands. The Japanese government now estimates total nuclear fatalities in the two cities—including belated deaths that can be traced to the bombs—at between 300,000 and 350,000. (Total U.S. combat deaths in the Pacific War numbered slightly less than 100,000.) Moreover, infants exposed to radiation *in utero* before the eighteenth week who were born mentally retarded now are 50-year-old retarded adults, many with elderly parents who agonize over what will become of these microcephalic “pika babies” after the parents die.

Another fact commonly neglected in the orthodox American treatment of the bomb is that thousands of the victims were not Japanese. According to Japanese

estimates, between 6,500 and 10,000 Koreans were killed in Hiroshima and Nagasaki; Koreans themselves put the number even higher. (Most of these Koreans were colonial subjects of Japan who had been conscripted for heavy labor.) The bomb also killed more than 1,000 second-generation Japanese-Americans who had been temporarily living in Hiroshima when the Japanese attacked Pearl Harbor in 1941 and whom the war had prevented from returning to the United States. Several hundred Chinese likely died in the nuclear blasts as well, along with small numbers of Southeast Asian students, British and Dutch POWs, and European priests. About two dozen Caucasian-American POWs survived the atomic bombing of Hiroshima, only to be beaten to death by Japanese *hibakusha*.

The Japanese Perspective

In Japan, as might be expected, popular memory of the atomic bombs tends to begin where the conventional American narrative leaves off—with what took place beneath the mushroom clouds of Hiroshima and Nagasaki. The Japanese dwell on the extraordinary human misery the bombs caused, providing intimate stories about the shattering of individual lives. Oe Kenzaburo, the 1994 Nobel laureate in literature, called attention to this in a series of influential essays written in the early 1960s. In Oe's rendering, the *hibakusha* were “moralists,” for they had experienced “the cruelest days in human history” and never lost “the vision of a nation that will do its best to materialize a world without any nuclear weapons.”

This perception of the significance of Hiroshima and Nagasaki—starkly different from that conveyed in the triumphal American narrative—clearly has the potential to become myopic and nationalistic. Japan risks turning the attacks on Hiroshima and Nagasaki into a “victimization” narrative, in which the bombs fell from the heavens without context—as if war began on August 6, 1945, and ended on August 9, and innocent Japan bore the cross of witnessing the horror of the new nuclear age. But Oe's account, like most other popular Japanese discourse on these matters, is more subtle than this. Since the early 1970s, the Japanese media have devoted much attention to the thesis that “victims” can simultaneously be the victimizers of others—as the *hibakusha* in Hiroshima demonstrated when they beat to death American POWs.

It is virtually a cliché in the U.S. media that the Japanese suffer from historical amnesia and are incapable of honestly confronting their World War II past. There is much truth to this. For many years, Japanese textbooks presented a sanitized version of the conflict. Schoolchildren were taught that Japan “advanced” into China, rather than “invaded” its neighbor. Doubt was cast on the reality of the Rape of Nanking. Japan's colonial repression of other Asians was barely mentioned. To the present day, conservative politicians have refused to support a clear and unequivocal official statement acknowledging Japan's acts of aggression and atrocity and forthrightly apologizing for them.

At the same time, however, domestic debate on these matters has been far more intense than the for-

eign media usually acknowledges. In recent years—especially since the death of Emperor Hirohito in 1989—the textbooks have become more forthright, while the Japanese national media have carried detailed commentary on virtually all aspects of Japan's war behavior. In this context, certainly in light of the fiasco at the Smithsonian, it is anomalous for Americans to be accusing others of sanitizing the past and suffering from historical amnesia.

In the end, one of the great legacies of World War II was the redefinition of the legitimate targets of war to include noncombatant women, children, and men. Japan itself was one of the first countries to act out this new view of war; its bombing of Chinese cities in 1937 was passionately condemned by the League of Nations and the United States as behavior beyond the pale of civilized people. Picasso's great mural of the bombing of Guernica in the same year by the fascists during the Spanish civil war evoked the shock that similar barbarity aroused.

By the end of World War II, however, even the democratic nations had accepted the targeting of civil-

ian populations as proper and inevitable. Earlier in 1945, British and U.S. air forces obliterated much of Dresden after previously fire-bombing other German cities. In Japan, U.S. saturation bombing devastated Tokyo and 63 other cities, killing around 100,000 civilians in Tokyo alone. The atomic bombs were simply a more efficient way of terrorizing enemies and destroying a newly legitimized target of war: civilian morale.

In the fires of Hiroshima and Nagasaki, triumph and tragedy became inseparable. At the same time, America's victory became fused with a future of inescapable insecurity. The bombs marked both an end and a beginning. They marked the end of an appalling global conflagration that killed more than 55 million people and the beginning of the nuclear arms race—and a world in which security was forever a step away. ■

JOHN W. DOWER is a professor of history and the Henry Luce Professor of International Cooperation at MIT. He is author of *War Without Mercy: Race and Power in the Pacific War* (Pantheon, 1986) and, most recently, *Japan in War and Peace: Selected Essays* (The New Press, 1994).

Revisionist History Has Few Defenders

The Smithsonian's proposed exhibit depicting the events surrounding Hiroshima and Nagasaki was so blatantly biased that Congress had no choice but to kill it.

PETER BLUTE

FOR most Americans, this war was fundamentally different than the one waged against Germany and Italy—it was a war of vengeance. For most Japanese, it was a war to defend their unique culture against Western imperialism.”

This quotation, from the original text of an exhibit proposed by the Smithsonian Institution's National Air and Space Museum, is one of the most arrogant, inaccurate, and offensive statements ever made about World War II. It exemplifies the reason why the Smithsonian was forced to severely scale back that exhibit, “The Last Act: The Atomic Bomb and the End of World War II.” A coalition consisting of members of Congress, historians, veterans’ organizations, and Smithsonian officials succeeded in stopping it because—and only because—it became clear beyond a doubt that the text and photographs proposed by the museum did not present a factual account.

The first-ever public showing of the *Enola Gay*, the airplane that dropped the atomic bomb on Hiroshima, was planned to coincide with the fiftieth anniversary of its mission. But the original proposal for the exhibit would have turned this event into a much broader and one-sided retrospective on the horror of nuclear



weapons, raising questions as wide-ranging as why the United States dropped the atomic bombs on Japan and whether those events inspired the antinuclear movements of the 1950s and 1960s.

Because of congressional intervention, the exhibit now contains only the restored fuselage of the airplane, a plaque briefly explaining its mission, and a video of the training and experiences of the flight

crew. Gone are the 32 photographs of Japanese casualties, weakly balanced with 7 photographs of American casualties. Gone are the 97 graphic images of Japanese suffering, juxtaposed against only 8 pictures reflecting the millions of innocent victims tyrannized, molested, tortured, and murdered in the rape of Nanking, the Bataan death march, the sneak attack on Pearl Harbor, and other infamous events orchestrated by the Japanese war machine from 1930 to 1945. The new exhibit will let the 8 million people who visit the museum each year form their own judgments about the war.

The proposed exhibit would not have provoked such a resounding outcry if the Air and Space Museum had decided to take a moderate approach to the subject. Many liberal critics have bemoaned the changes

PROGRESS IS POSSIBLE ONLY WHEN A SOCIETY CAN IDENTIFY ITS MISTAKES AND MOVE BEYOND THEM. FOR THIS TO HAPPEN, HOWEVER, THE STORIES OF THE PAST MUST BE TOLD TRUTHFULLY.



The original proposal for the Enola Gay exhibit, coinciding with the fiftieth anniversary of its mission, would have turned this event into "a much broader and one-sided retrospective."

in the exhibit as congressional meddling in the arts. The fact is that this depiction was so biased it was impossible for Congress and other defenders of historical accuracy not to get involved. The handful of individuals who wanted to retain the original plan could not count among their supporters even one of the 535 members of Congress. Even the liberal *Washington Post* editorialized in January that "The fuselage of the *Enola Gay* is an emotion-soaked artifact and a piece of historical heritage that the American people deserve to get a look at. They also deserve a historical presentation worthy of the subject and of the standards of the Smithsonian."

At risk in this controversy was the reputation of one of the finest museums in the world. When the Smithsonian Institution was established, close to 150 years ago, its purpose was clear. It was founded "as an establishment for the increase and diffusion of knowl-

edge." The proposed *Enola Gay* exhibit was not formulated in that spirit but rather was based on unsupported bias, revisionism, and disregard for truth. The Smithsonian fulfills both a historical and an educational role; American children, many of whom will learn about the atomic bombing of Japan for the first time as they wander through the Air and Space Museum, deserve better.

The study of history is a vital tool for the development of any society. Progress is possible only when a society can identify its mistakes and move beyond them. For this to happen, however, the stories of the past must be told truthfully. Revisionist history defeats this goal.

The restored *Enola Gay* is a physical manifestation of one of the most contentious issues our country has ever faced. The decision to drop the atomic bomb was an extremely difficult one, but it was also a morally unambiguous decision that ended a terrible war and saved countless American lives. Rational minds can agree or disagree about whether the Air and Space Museum—dedicated to the technology of flight—should undertake a wide-ranging exhibit on the end of the largest war ever fought, or whether it should simply display the plane that ended it. But there is no question that once our national museum makes the commitment to pursue a broad-based exhibit, it should do so in an accurate and balanced fashion. ■

PETER BLUTE, a member of the U.S. House of Representatives (R-Mass.), was one of the original congressional critics of the National Air and Space Museum's proposed exhibit and led a year-long fight to change it.

Second-Guessing History

To appreciate the events that led up to the dropping of the atomic bomb, you really had to be there.

I.B. HOLLEY, JR.

THE controversy over the *Enola Gay* exhibit at the Smithsonian's Air and Space Museum quickly got out of hand, and as one might expect where emotions run high, there seems to have been a good deal of misunderstanding. In hopes of clarifying matters rather than adding to the confusion, let me offer a personal reaction to the original exhibit.

The Air and Space scriptwriters left the impression that the United States was the aggressor and was motivated by racist antipathy toward the Japanese people. Further, they implied that dropping the atomic bomb was a mistake, belittling analysts such as Gen. George Marshall, who estimated that there might have been a million casualties if the Allies had invaded Japan and who concluded that using the



bomb would actually save lives, both Allied and Japanese.

I was a graduate student at Yale when Pearl Harbor changed our lives. I enlisted not long afterward, not out of hotblooded emotionalism but from a moral conviction that Hitler and Tojo had to be stopped. To assert that millions of us entered the war because of

racist antipathy toward the Japanese people is downright insulting. So, too, is the suggestion that the United States started the war.

Was dropping the bomb a mistake? It depends on your perspective. All reasonable people may wish it had never happened, and all humane souls must anguish at the suffering it caused in Japan, not to mention the blight it cast over the years that followed. But

as an Air Force officer at the time, I was much relieved when the bombs were dropped—as were my contemporaries in the armed forces and the people of the United States as a whole. The bombs ended the war, and no amount of second-guessing can take away the satisfaction we all felt with that outcome. Unless one was around at the time, and especially in the military, one simply isn't in a position to understand.

All war is terrible. I doubt it really matters to those killed that the atomic bomb rather than the fire storm at Dresden was the cause of death. The real issue hinges on the question, Did the bomb save lives in the long run? There is no way one or another estimate can be certified as correct. But I give more credence to the sober judgment of Gen. Marshall, the official responsible for advising the president at the time, than to the Monday-morning quarterbacking of scholars long after the event.

If the Smithsonian scriptwriters had confined themselves to a demonstration of the horrible consequences of the atomic bomb, I think few rational people would have objected. And one can legitimately debate the wisdom of its use. But the scriptwriters instead offered a one-sided view that impugned the motives of millions of veterans who put their lives on the line when the nation was attacked, and asserted that Japan was merely defending its unique culture.

That unique culture, by the way, bears scrutiny. Should we ignore the savage behavior of the prewar militarist fanatics who assassinated moderate members of the Diet? Should we ignore the thrust into

Manchuria and the rape of Nanking? Should we celebrate the unique culture that subjected prisoners of war to torture and death? Should we ignore the Japanese threat to kill all POWs in Japan if Allied invaders ever set foot on the home islands? The Smithsonian scriptwriters did ignore these actions, while singling out the United States for opprobrium.

The healing process between the two countries has been long and slow. It is now exacerbated by a trade war, but fair-minded citizens of both nations know that friendship and mutual understanding must be our goals. The Smithsonian scriptwriters seriously impaired the healing by their failure to practice the objectivity and balance that is the hallmark of sound historical scholarship. ■

I.B. HOLLEY, JR., is an emeritus professor of history at Duke University and author of several volumes on twentieth-century warfare. Enlisting shortly after Pearl Harbor, he ended the war as a captain in the Air Force.

The Bomb Minimized Casualties

Given the huge death tolls of both Americans and Japanese during the Pacific War, the invasion of Japan that the atomic bombs rendered unnecessary would have been a bloodbath.

**NORMAN POLMAR AND
THOMAS B. ALLEN**

NO one denies the horrific destruction that the atomic bombs wreaked on Hiroshima and Nagasaki. But in discussing the end of World War II, we must remember that the alternative course of action—an invasion of Japan—would have killed even more Japanese, as well as hundreds of thousands of U.S. soldiers, sailors, and Marines.

The Pacific War had yielded a horrifying loss of life on both sides. The 3-day U.S. assault on the heavily fortified Tarawa atoll in November 1943, for example, killed nearly 1,000 U.S. Marines and wounded twice that many. U.S. commanders—and Americans back home—were shocked at this heavy toll and at the Japanese tenacity: only 17 of the 4,836 Japanese troops survived. But the bloody assaults of the Central Pacific campaign continued: Kwajalein, Eniwetok, Peleliu, Saipan, Tinian, Guam. Everywhere, the Japanese fought to the end. On Saipan, for example, where U.S. losses totaled 16,525 dead and wounded, all but 1,000 of the 30,000 Japanese on the island died—some committing suicide by jumping from cliffs with civilians who believed the horrible tales of American barbarism told by the Japanese. It took 26 days of savage fighting for the U.S. Marines to take Iwo Jima—an island of only 7.5 square miles, or less than one-third the size of Manhattan. The battle for this island killed 6,821 Americans and wounded several times that number.

This is the bloody backdrop against which the United States began, in the spring of 1945, to plan the endgame of the Pacific War: a massive assault on the Japanese home islands. In the plan, a force of 14 U.S. Army and Marine divisions would storm ashore on Kyushu, the southernmost of the home islands, on or about November 1, in an invasion named Operation Olympic. If Japan did not surrender, an even larger invasion of the main island of Honshu would occur in March 1946, code-named Operation Coronet. Those would have been the largest amphibious landings of World War II—much larger than the Normandy D-Day landings—and undoubtedly would have led to the bloodiest battles of the war.

American commanders viewed the assault on the island of Okinawa from April to June 1945 as a prelude to—and model for—the battle for the Japanese home islands. At Okinawa, the equivalent of less than three Japanese divisions, with no possibility of relief or victory and heavily pounded by U.S. aircraft and naval bombardment, held out for more than 100 days against a larger American ground force with massive close air support. The





Gen. George C. Marshall advised President Truman that an invasion of Japan would cost from a quarter of a million to a million American lives, with an equal number of the enemy.

battle killed 12,520 U.S. soldiers, sailors, and Marines, and wounded another 36,631. The Japanese losses were hideous: an estimated 107,000 dead, including Okinawan civilians.

As the battle for Okinawa raged, evidence mounted that the battle for the home islands would be even more savage. Decoded Japanese communications gave indications of Japan's preparations for the U.S. invasion: as Germany was about to fall, for example, the Japanese Army general staff cabled the Japanese military attaché in Lisbon asking for full reports of German resistance to Allied forces, "to furnish reference material for the decisive battle in our homeland and particularly for the training of special guard units and citizens' volunteer units." An intercepted dispatch from the Swiss minister in Tokyo said that Japan's strategy was to "prolong the war as long as possible." Many in the Japanese high command, the message continued, "eagerly desire the landing of the Americans in Japan proper, since they think it would be the last chance to inflict upon the Americans a defeat serious enough to make them come to terms."

Interrogations of high-ranking Japanese staff officers after the war confirmed that in the summer of 1945 the Japanese were far from ready to give up fighting. To the contrary, the Japanese wanted to inflict unacceptable losses on U.S. forces attacking Kyushu in hopes that the United States would shy away from a full-scale assault on the main island and negotiate a settlement with Japan.

How Many Would Die?

In June, President Truman asked the Joint Chiefs of Staff for an estimate of the probable cost, in U.S. lives, of the forthcoming assault on Japan. Gen. Douglas A. MacArthur, who would command the landings in Japan, sent his casualty estimates for the expected 90-day campaign to seize the southern half of Kyushu: a total of 95,000 battle casualties—dead and wounded—plus another 12,000 men who would be killed or put out of action by disease and accidents. Gen. George C. Marshall, the Army chief of staff, intimated to MacArthur that so high a casualty rate would make Truman postpone the invasion. MacArthur lowered his estimate.

In response to Truman's query, the planning staff of the Joint Chiefs prepared several casualty estimates. One put the number of Americans killed and wounded

as high as 132,000 for the conquest of Kyushu, plus another 100,000 if the landing on Honshu followed. There was also abundant evidence that the 100,000 American, British, and Australian POWs then held by the Japanese would have been killed when U.S. troops landed in Japan.

After learning details of the successful atomic bomb test at Alamogordo, N.M., in July 1945, Truman again asked his principal advisers to estimate the cost in lives of an invasion. Truman wrote in his memoirs that he was told by Gen. Marshall that "such an invasion would cost at a minimum one quarter of a million casualties, and might cost as much as a million, on the American side alone, with an equal number of the enemy." Secretary of War Henry Stimson made a similar estimate in his postwar memoirs.

Meanwhile, two U.S. Army agencies made independent estimates of invasion casualties. The battle-seasoned medical staff on Luzon in the Philippines estimated that the Kyushu assault and subsequent fighting to secure the southern half of the island would cost 394,000 Americans dead, wounded, and missing. And the Philadelphia Quartermaster Depot—which procured for the Army everything from combat boots to medals—ordered more than 370,000 Purple Hearts to award to the wounded and the families of those killed in the final battles for Japan. (This batch of Purple Hearts supplied the Army for the entire Korean, Vietnam, and Gulf wars.) If these Army calculations had proved to be anywhere near accurate, the assault on Kyushu would have been the bloodiest invasion in history.

Such casualty figures added to Truman's conviction that he needed to use the bomb. And it took not one but two atomic bombs to convince the Japanese to call off the war. The six-man committee that ruled Japan was split three to three on surrender until the 13th—four days after the Nagasaki bomb—when the emperor decided for peace. Even then, it was a close thing. Soldiers took over the Imperial Palace and attempted to stop the surrender. The head of the Imperial Guards division was killed and the palace police force captured and confined. Throughout Japan, soldiers, airmen, and civilians refused to surrender—many defying orders from their superiors.

A third atomic bomb would have been built by the end of August, and it probably would have been dropped on another city had the Japanese not surrendered. More atomic bombs were in production. And from what is now known about Gen. Marshall's thinking, the United States would have used nuclear bombs in a tactical role to support the invasion. American commanders also proposed employing poison gas, crop-killing chemicals, and even biological weapons against the Japanese in an effort to hold down U.S. casualties. The devastation of Japan could have been total. ■

NORMAN POLMAR and THOMAS B. ALLEN are co-authors of Codename Downfall: The Secret Plan to Invade Japan and Why Truman Dropped the Bomb, published in July by Simon & Schuster.

What Scientists Knew and When They Knew It

When the creators of the atom bomb learned that Japan was to be the target, only a minority favored "full use" of the weapon.

RONALD TAKAKI

SCIENTISTS of the Manhattan Project recently claimed they were surprised to learn from an article by nuclear physicist Arjun Makhijani that Japan had always been the target of the weapon they developed. Had they known this "back then," some of them suggested in a *New York Times* report of April 18, 1995, the nuclear effort might have been "slowed" or "crippled." Physicist Hans A. Bethe was quoted as saying, "Most of us considered the Nazis the main enemy."

But history invariably turns out to be more nuanced than its participants will admit. Contrary to the recollection of some Manhattan Project veterans, the bomb scientists knew in May 1945—three months before the explosion at Alamogordo—that Japan was the target. In fact, as a member of the Target Committee, Los Alamos Laboratory director J. Robert Oppenheimer recommended on May 11 that the bomb be used against Japan.

When the scientists learned that plans for an atomic attack on Japan were under way, many of them did indeed organize to stop the bombing—but it was beyond their power to cripple the weapon's development. Leo Szilard of the Chicago Metallurgical Laboratory decided that he and his fellow atomic scientists should forthrightly declare their moral opposition to the use of the atomic bomb—a weapon of mass and indiscriminate killing of civilians—against Japan. Szilard drafted a petition to Truman. It exhorted, among other things, "that you exercise your power as Commander-in-Chief, to rule that the United States shall not resort to the use of atomic bombs in this war unless the terms which will be imposed upon Japan have been made public in detail and Japan knowing these terms has refused to surrender. . . ."

Szilard admitted to his fellow scientists that the petition would be futile. "However small the chance might be that our petition may influence the course of events," he wrote to a colleague on July 4, "I personally feel that it would be a matter of importance if a large number of scientists who have worked in this field went clearly and unmistakably on record as to their opposition on moral grounds to the use of these bombs in the present phase of the war." In other letters, he argued that "from a point of view of the standing of the scientists in the eyes of the general public one or two years from now it is a good thing that a minority of scientists should have gone on record in favor of giving greater weight to moral arguments and



should have exercised their right given to them by the Constitution to petition the President."

Szilard's petition prompted the Manhattan Project leaders to poll the atomic scientists in July, asking them whether and how the weapon should be used against Japan. The options presented were:

1. *Use the weapons in the manner that is from the military point of view most effective in bringing about prompt Japanese surrender at minimum cost to our armed forces.*
2. *Give a military demonstration in Japan, to be followed by a renewed opportunity for surrender before full use of the weapon is employed.*
3. *Give an experimental demonstration in this country, with representatives of Japan present, followed by a new opportunity for surrender before full use of the weapons is employed.*
4. *Withhold military use of the weapons, but make [a] public experimental demonstration of their effectiveness.*
5. *Maintain as secret as possible all development of our new weapons, and refrain from using them in this war.*

Only 15 percent voted for number 1, while 46 percent voted for number 2, 26 percent for number 3, 11 percent for number 4, and 2 percent for number 5. Thus 85 percent of the scientists voted against the way the bomb would actually be employed at Hiroshima and Nagasaki—the surprise "full use" of the bomb.

On July 13, 1945, the poll's results were transmitted to Arthur H. Compton, project leader of the Chicago Metallurgical Laboratory. Three days later, the first atomic bomb was exploded at Alamogordo. On July 24, in a memo to Colonel K.D. Nichols, who worked under the Manhattan Project's director, General Leslie Groves, Compton forwarded Szilard's "A Petition Addressed to the President of the United States," dated July 17. Sixty-seven scientists had signed.

General Groves received the petition on July 25 but held onto it until August 1, when he finally forwarded it to Secretary of War Henry L. Stimson.

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Stimson was at the Big Three meeting in Potsdam, Germany, and did not see the petition until his return later that month.

By then it was too late. Hiroshima had happened. On August 6, Szilard wrote to his close friend and future wife, Trude Weiss: "I suppose you have seen today's newspapers. Using atomic bombs against Japan is one of the greatest blunders of history. Both from a practical point of view on a 10-years scale and from the point of view of our moral position. I went out of my way (and very much so) in order to prevent it but, as today's papers show, without success. It is very difficult to see what wise course of action is possible from here on."

While Oppenheimer, unlike Szilard, supported the deployment of the bomb in combat against Japan, he nevertheless felt an agonizing uncertainty about the unleashing of this "shatterer of worlds."

On August 6, 1945, he received a phone call from Groves. The general said that the bomb had gone off with a "tremendous bang," and that he was glad he had appointed Oppenheimer director of Los Alamos. In fact, Groves said, that move had been "one of the wisest things" he had ever done. "Well," Oppenheimer replied, "I have my doubts, General Groves." After the atomic bomb was dropped on Hiroshima, the physicist reported having "terrible

moral scruples" about the killing of 70,000 people.

On October 16, when Oppenheimer stepped down as director of the lab, the entire Los Alamos community gathered to honor him; General Groves presented him with the secretary of war's Certificate of Appreciation. But Oppenheimer did not share the euphoria of the moment, and even lent a somberness to the event. In a short speech he wondered how future generations would remember the Manhattan Project: "If atomic bombs are to be added as new weapons to the arsenals of a warring world, or to the arsenals of nations preparing for war, then the time will come when mankind will curse the names of Los Alamos and Hiroshima."

The bombing of Hiroshima marked a crossing to a new level of international violence, the horror of which was not lost on atomic scientists like Szilard and even Oppenheimer. They could have pleaded scientific neutrality, claiming that they were merely the technical creators of the bomb, not the military and political decision makers. They could have tried to avoid moral responsibility. But they found themselves murmuring, as did the butler Stevens in Kazuo Ishiguro's *Remains of the Day*, upon realizing he had failed to confront the great ethical issues of World War II: "Really—one has to ask oneself—what dignity is there in that?" ■

RONALD TAKAKI, a professor of Asian-American studies at the University of California, Berkeley, was distinguished Messenger lecturer at Cornell University in 1993. His most recent book is *Hiroshima: Why America Dropped the Atomic Bomb* (Little, Brown, 1995).

Appointing Oppenheimer director of Los Alamos, said Gen. Groves, was "one of the wisest things" he had ever done. "Well," Oppenheimer replied, "I have my doubts."

Tales of the City

There are many ways to represent Hiroshima. In a democracy, we should be exposed to all of them.

HUGH GUSTERSON

These are not easy times to be a museum curator. Museum exhibits are supposed both to represent some kind of social consensus about the past and, ideally, to challenge people to look at the world in new ways. That combination can be a problem when the subject matter is controversial, there is no consensus to represent, and the dominant interpretations among scholars are at odds with those that prevail in the public domain.

Curators at the Smithsonian certainly discovered this recently, though it was not the first time a museum's representation of A-bomb history had drawn fire. The exhibit on the Manhattan Project and



nuclear weapons at the Bradbury Science Museum in Los Alamos, the city that built the Hiroshima bomb, is in some ways a mirror image of the exhibit originally planned for the Smithsonian: its 20-minute documentary film on the Manhattan Project skips straight from the first nuclear test in the New Mexico desert to

V-J Day without even mentioning the words Hiroshima or Nagasaki, and the museum exhibit as a whole raises no questions about the bombing of Hiroshima or about the arms race that followed—or did not until antinuclear activists sued five years ago and won the right to display their own small counterexhibit within the museum. The counterexhibit,

which features photos of dead and injured Japanese, makes the case that the bombing was an unnecessary atrocity. It is accompanied by a large blank book for public responses, which has become the site for a spontaneous and impassioned, indeed often abusive, debate on Hiroshima among visitors to the museum.

I look at these disputes over public representations of Hiroshima through the prism of my own anthropological research on the culture of weapons scientists at America's other nuclear weapons research center, the Lawrence Livermore Laboratory in California. One notices three things about how Livermore scientists represent Hiroshima in their discourse. First, they rarely mention Hiroshima at all. Indeed, the erasure of Hiroshima can be so profound that I have even heard Livermore scientists, explaining how nuclear weapons are different from other kinds of weapons, say that these are the only weapons that have never been used.

Second, with a few exceptions, it is generally taken for granted at Livermore that America was right to bomb Hiroshima and Nagasaki because this brought the war to a swift end. Third, when scientists do discuss the bombing of Hiroshima, they prefer to render the ethics and politics of the bombing as a math problem—a calculation of the number of lives lost versus the number saved by the bombing.

In other words, most of the discourse about Hiroshima at Livermore is marked by reticence, abstraction, and rhetorical rationalism. This particular way of telling the story not only legitimizes the bombing; it also, in using Hiroshima as an origin tale for the Cold War, seeks to fix a definition of nuclear arms as weapons that save lives and of American leaders as people who can be trusted to use such weapons rationally.

This way of representing Hiroshima, although dominant at Livermore and, with variations of tone, across the United States, is only one among many. Other narratives, like John Hersey's *Hiroshima*, emphasize the suffering of the Japanese people, transforming them from numbers into individuals with unique stories and sentient bodies; or they suggest that American leaders were motivated by racism rather than compassionate rationalism; or they argue that American leaders were indeed rational in 1945 but in the most cynically calculating way, using the bombing of Hiroshima and Nagasaki to send an intimidating message to the Soviets.

Pictures of Hiroshima—especially pictures of individual A-bomb victims—have a particular power to undermine the official narrative of Hiroshima by arousing strong feelings of horror and of empathy for the victims, and by forcing the viewer to engage with Hiroshima as something more than an abstract calculus. That is why the U.S. military immediately censored all footage of Hiroshima and Nagasaki in 1945. It is also why antinuclear activists made a point of bringing images of dead and dying A-bomb victims into the Bradbury Science Museum in Los Alamos; why they bring them to the gates of the Livermore Laboratory every year on Hiroshima Day; and why veterans' groups and conservative politi-

cians wanted them censored out of the Smithsonian exhibit, together with evidence uncovered by historians that the government's official math about Hiroshima does not add up.

But surely, if it was truly right to bomb Hiroshima, then we should be able to look at the bodies torn and burned by the bomb and still say that, however regrettable, it was the right thing to do. Great nations, like great people, are not those that make or admit no mistakes but those that have the courage to reconsider their pasts as they grow. This year, with the benefit of 50 years' hindsight, we had the opportunity to enlarge our vision of Hiroshima by asking new questions and hearing new voices. The Japanese grasped that opportunity in 1994 by adding a new wing to the Hiroshima Museum that, for the first time, relates Hiroshima to the Japanese war effort. The exhibit has been controversial because it shows, among other things, Koreans and Chinese brought to Japan as forced labor. Japanese conservatives protested the exhibit but were overruled.



At the Bradbury Science Museum in Los Alamos a vibrant public debate has been created where none existed before because different representations of Hiroshima were juxtaposed. In the Smithsonian controversy, however, critics did not protest by requesting a public counterexhibit or a debate; instead, they lobbied for the censorship and repression of an exhibit that they did not like. The veterans among them who fought for democracy 50 years ago in the Pacific thus helped kill it this year in the Smithsonian, and we are all the poorer for it.■

HUGH GUSTERSON, an assistant professor of anthropology and science studies at MIT, is using a MacArthur Foundation fellowship to study the culture of weapons scientists at national laboratories in the United States and Russia. He is the author of Testing Times: A Nuclear Weapons Lab at the End of the Cold War, forthcoming from the University of California Press.

Pictures of Hiroshima have a particular power to arouse strong feelings of horror and force the viewer to engage with the bombing as something more than an abstract calculus.

The Age of Numbing

Like the survivors of the atomic bombings, Americans have sought to distance themselves from the consequences of Hiroshima and Nagasaki—with devastating effects.

ROBERT JAY LIFTON AND GREG MITCHELL

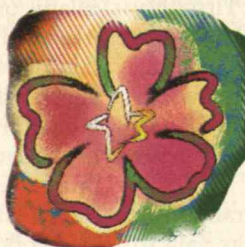
AN important, but largely unexamined, dimension of Hiroshima is the lasting psychological, ethical, and political impact on those who used the first nuclear weapons and continued to develop them. The cumulative influence of Hiroshima is much greater than most Americans suspect. Indeed, one may speak of the bomb's contamination not only of Japanese victims and survivors, but of the American mind as well.

From the time of Hiroshima, Americans have assigned themselves the task of finding virtue in the first use of the most murderous device ever created.

These efforts have taken us to the far reaches of moral argument. We have felt the need to avoid at any cost a sense of moral culpability for the act. And there has indeed been a cost, one much greater than we wish to recognize.

"Psychic numbing" can be defined as a diminished capacity or inclination to feel. Hiroshima survivors remember witnessing at the time of the bomb terrible scenes of suffering—nothing less than a sea of death around them—but found very quickly that they simply ceased to feel. They spoke of "a paralysis of the mind," of becoming "insensitive to human death," of being "temporarily without feeling." This useful defense mechanism prevents the mind from being overwhelmed and perhaps destroyed by the dreadful and unmanageable images confronting it.

But psychic numbing extends further, to those who created the weapon, made the decision to use it, or carried out the atomic bombing. While the tendency toward numbing in relation to Hiroshima is universal, it is bound to be greatest in Americans, where it serves the additional purpose of warding off potential feelings of guilt. As in the very different case of German attitudes toward Auschwitz, we have not wished to permit Hiroshima to enter our psyches in ways that could affect our feelings. Hence we construct around Hiroshima what the American philosopher Edith Wischograd calls a *cor-don sanitaire*, a barrier designed to prevent the spread



of a contagious illness—the illness in this case being the awareness of what we did there. Indeed, the establishment of a *cor-don sanitaire* has been the official policy of the American government.

From the start, Americans were not shown the human impact of the bomb. Government and military officials sought

to hide its grotesque effects and so to deny the weapon's revolutionary significance. The visual record of the atomic bombings was largely restricted to shots of rubble.

Though the U.S. government officially ended wartime censorship at home on August 15, 1945, articles and photographs documenting the use of the atomic bomb remained under strict review. In Japan, censorship continued throughout the Occupation: American military officials destroyed or withheld all photographs taken by Japanese citizens following the bombings and banned all filming at the two sites.

The first photographs of the ruins shown in the United States were taken from the air at the end of August 1945. Though stark, they hardly did justice to the catastrophe; Hiroshima looked much like the incinerated section of Tokyo, except that the rubble was more pulverized. There was no way of knowing that much of Tokyo remained standing, while nearly all of Hiroshima had been destroyed. A few days later, magazines began to publish photographs taken from the ground. The photographs in *Life* magazine, for instance, showed a "still stinking junk-pile," as one caption put it: factory ruins, charred trees and telephones, the skeleton of a bus. There were no injured Japanese in these photographs, no doctors and nurses treating the ill and wounded, no funeral pyres, no one mourning.

It wasn't that *Life* was squeamish. In August it had published a gruesome series of photos of a Japanese soldier in Borneo set on fire by a flamethrower. But in that instance, only one person died; he was a combatant, not a civilian; and the wielder of the weapon was Australian, not American.

Shortly after the bombings, the U.S. Strategic Bombing Survey did hire a Japanese film crew, supervised by Lieutenant Daniel McGovern, to shoot a three-hour black-and-white documentary chronicling the effects of the bomb. But the film was declared top secret, locked away, and never shown to the American public. In early 1946, an American crew, also super-



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vised by McGovern, filmed the only color footage taken in Hiroshima and Nagasaki. It too was stamped top secret and remained hidden for more than three decades, despite strenuous efforts by one of the filmmakers to win its release. McGovern later recalled, "The AEC (Atomic Energy Commission), the Pentagon, and the Manhattan Project people . . . were fearful because of the horror it contained. They didn't want that material shown, because it showed effects on men, women, and children."

The federal government established a similar pattern of obscuring the truth about radiation. Fallout was absent in every account of the immediate aftermath of the Hiroshima bomb. Although the effects of radiation were well known, atomic scientists and military officials publicly dismissed as hoaxes and propaganda Japanese reports of a soaring death toll and "ghost parades" of the living doomed to die. A research team sent to Hiroshima in September 1945 by Gen. Leslie Groves, the military head of the Manhattan Project, was told, in the words of one member, that "our mission was to prove that there was no radioactivity from the bomb."

Of all the aspects of the bomb considered too sensitive for public consumption, radiation was perhaps the most sensitive. The effects of radiation symbolized the bomb's radical discontinuity with previous weapons, its special character as a destroyer of human beings not only at the moment of impact but throughout survivors' lives and across generations. Our government's need to deny the most disturbing aspect of these weapons has extended to situations that endanger its own people—workers in the nuclear weapons industry, residents of communities adjoining nuclear facilities and test sites, soldiers exposed to radioactive fallout, and the hundreds of Americans subjected to radiation experiments, often without their consent.

No wonder, then, that the American people have come to feel deceived by the bomb and its caretakers. We sense that ominous truths have been withheld from us. Hiroshima was the mother of all cover-ups: it spawned patterns of distortion, manipulation, and concealment that have contaminated American life ever since—from Vietnam to Watergate to the Iran-Contra affair. We have to ask ourselves how much of our rising mistrust of politicians and officials of all kinds—the angry cynicism so evident in our public life—emanates from the Hiroshima and post-Hiroshima nuclear deceptions.

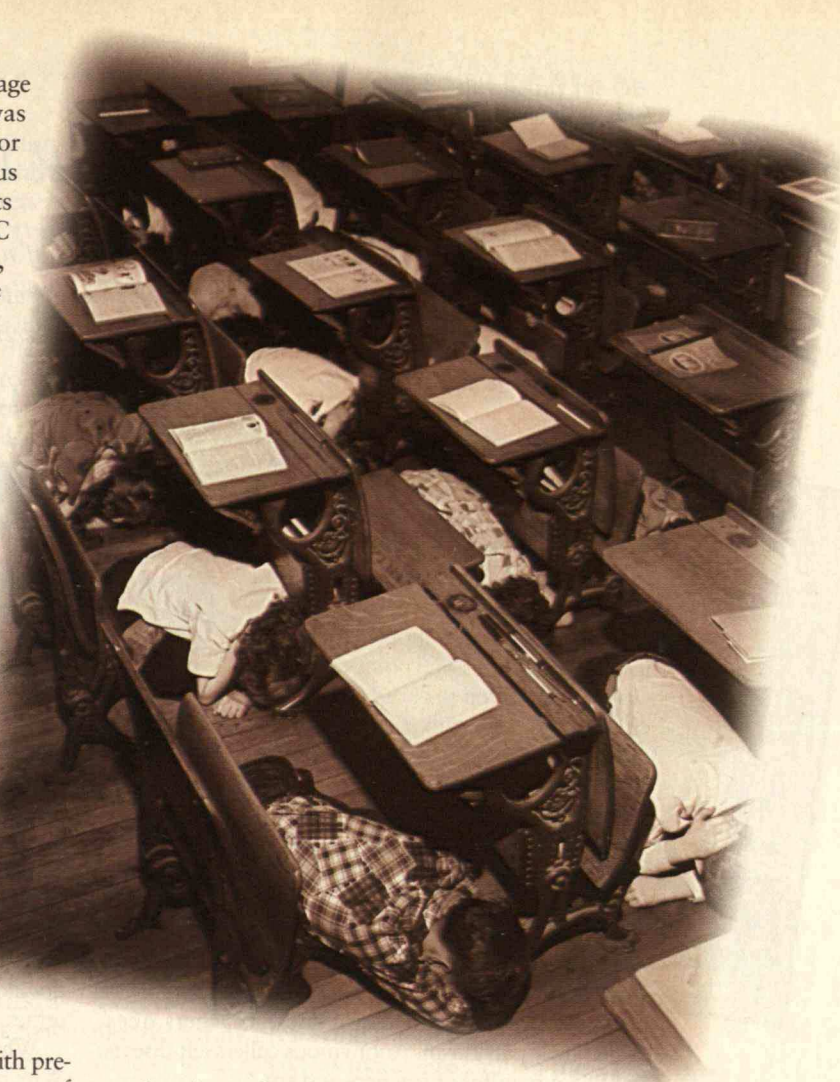
Over time, the boundaries of numbing can blur. By closing ourselves off from the human costs of our devastating weapon, we are more able to do the same when confronted with other instances of collective suffering—the 1994 genocides in Bosnia and Rwanda, for example. We can become increasingly insensitive

to the physical violence around us, as well as to the institutionalized violence of poverty and homelessness. The tendency toward numbing can even extend to everyday forms of human interaction. As a character in an Alice Walker novel puts it: "The trouble with numbness . . . is that it spreads to all your organs, mainly the heart. Pretty soon after I don't hear the white folks crying for help, I don't hear the black."

If we can speak of an age of numbing, especially for Americans, much of it begins with Hiroshima. But confronting Hiroshima can be a powerful source of renewal. It can enable us to emerge from nuclear entrapment and rediscover our imaginative capacities on behalf of human good. We can break out of our individual and cultural habits of numbing. We can cease to justify weapons or actions of mass killing. And we can end our national self-betrayal by freeing our society from patterns of concealment. ■

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Effects of the bomb on men, women, and children were considered too sensitive for public consumption. The federal government also obscured the truth about radiation.



"Let's Not Talk About the Bad Things"

*Clinging to a rosy view of nuclear history
denies Americans an opportunity
for healthy reflection.*

PAUL ROGAT LOEB

FIFTY years after the plutonium factory at Hanford, Wash., produced the raw material for Alamogordo and Nagasaki, the local high school team, the Richland Bombers, still wears mushroom clouds on its football helmets. When I asked about the ubiquitous image that at one point even decorated graduation programs, the principal called it a symbol of peace. The student president explained, "It's just a cool aggressive symbol. We win lots of games with it. Did you know we went to State last year?" Most defenders treat the logo as having no more consequence than if the community had built its economic base on Colgate and its high school teams had decorated their helmets and jerseys with miniature toothpaste tubes.

Some students did try to change the high school emblem in the sixties, at the height of Vietnam-era protests. Peers called them names. Teachers questioned their patriotism. Anonymous callers left threats. In 1988 a handful of teachers and students tried again to



from Japan asked them to reconsider, the principal responded, "We did not start that war," and abruptly walked out of the room.

I thought of the Richland Bombers during the recent debate over the Smithsonian's representation of Hiroshima. From the vantage point of the American Legion and other critics, it was unpatriotic, "one-sided," and "politically correct" even to include the voices of men like Dwight D. Eisenhower or Admiral William Leahy, Roosevelt's chief of staff during World War II, who doubted the necessity of dropping the bomb. Never mind that such dissent reflected gloriously on the Legion's constituency (for if the Pacific War was essentially won by August 1945, it was thanks to the soldiers, sailors, and fliers who had carried the day in battles like Midway, Iwo Jima, and Guadalcanal). To the critics, it was a betrayal of sacrifice even to question.

Why couldn't the Hanford teams change their logo? Why can't ordinary Americans be trusted to hear the contending voices on whether the bomb should or should not have been dropped? Why is questioning our past so difficult?

I spent three years in and out of Hanford's surrounding communities, writing about what it meant to live and work in a complex that has produced the plutonium for over half the atomic weapons in America's arsenals. I found that Hanford residents systematically buried questions about the purpose and consequence of the enterprise. Workers went to their jobs day after day, explaining in retrospect, "I could have been making lightbulbs. I could just as easily have been working in a coal plant." In the words of one veteran engineer, "The government presented us with what they needed, and we went out and built it."

When workers did have qualms, they deferred to those they called "The Men Who Know Best," the people in Congress and the Pentagon who gave the directives to make the weapons they fueled. One night, at a bridge club, I asked the women what their husbands did and did not tell them about workplace accidents. One participant exclaimed, "Let's not talk about the bad things," then changed the subject to presidents who had visited the site and a local graduate who played for the Pittsburgh Steelers. The shift in topic was near-automatic, like a switch shunting a train onto a different track.

change the logo. Again, the Hanford community closed ranks and said the mushroom cloud was a symbol of pride, and that to change it would betray local tradition. Some 90 percent of students and 75 percent of the staff voted to retain it. When a visiting group of bomb survivors



Look Back in Blinders

Part of the difficulty with raising such prickly historical questions as the necessity or legacy of the bomb is simple inertia. We don't talk about these matters in our daily lives. We aren't used to questioning. It's easier simply to ignore them.

Yet America also has a strain of triumphalism, which insists that all this nation has done is right, good, and just. It's hard to acknowledge that the dedicated efforts of Hanford's workers have produced not a cause for jubilation but for concern: about the stack releases of hundreds of thousands of curies of radioactive materials—as in the deliberate 1949 test called the Green Run—that have left a plague of cancer, thyroid illness, and other health problems in downwind communities; about the waste tanks, ostensibly temporary, from which hundreds of thousands of gallons of radioactive materials have leached into the ground, in some cases reaching the water table; about the ultimate brinksmanship of weapons systems that retain the capacity to annihilate the human species.

After Secretary of Energy Hazel O'Leary announced the declassification of long-secret energy documents in December 1993, America seemed ready to begin facing this legacy. But the brouhaha at the Smithsonian signals a different path, one that clings to the myths of this nation's immaculate perfection.

These myths nestle closely with those that buttress a national security state whose proponents call for continued military expansion even though America's post-Cold War Department of Defense allotment totals \$265 billion, or more than the combined military budgets of the next half-dozen biggest-spending countries in the world. If citizens can be convinced that everything this enterprise has done is right and necessary, they will not question its current path. If they are allowed a glimpse of the awful assumption behind the development of nuclear weaponry—that ordinary human lives are expendable—citizens are far more likely to be restive.

The history of the bomb is particularly loaded because it brought the potential for global annihilation. A few voices from the thick of the arms race, like H-bomb developer Edward Teller, have argued that there was no need to drop the original weapon on a civilian population. Yet most conservative commentators have treated the necessity of Hiroshima and Nagasaki as a theological first principle, an action that cannot be questioned lest the entire edifice that followed collapse in its wake. They have framed the decision to create and use the Bomb as part of a continuing American narrative of destiny and virtue, beginning with the first white settlement of the continent and continuing to a present era where history has ended and the corporate market system is becoming the universal human future.

Proponents of such grand narratives rationalize them through specific pulls of loyalty, notably to brave men and women in uniform. But if critics suggest

Hiroshima was needless, do they really betray the GIs who fought and lost their lives in the Pacific War, and were ready to fight and die in the invasion of Japan? We saw the emotional impact of such calls for solidarity in the 1991 Persian Gulf War, which, when it wasn't a Fourth of July spectacle portrayed literally from the point of view of the bombs, was presented almost as if it were being fought for the safety of the very American soldiers who were over there at risk.

Sacrifice is redeemed neither by blind faith nor by a retro-



spective chorus of unanimity, but by preserving the freedom for which the sacrifice was made. Freedom in this case includes the ability to look, without blinders, at our past national choices so that we can better shape our future ones. If Hiroshima and Nagasaki signaled not just the ending of one war but the first shots fired in a new one, if America's military has since participated in repeated undertakings of dubious morality and wisdom, and if needless military spending continues to starve both economic infrastructure and urgent human needs, then we ought to examine the critical junctures where we first headed down the paths we continue to follow.

The dropping of the bomb is one of those key actions whose consequences continue to rebound. Its legacy is no more explained by the mute fuselage of the *Enola Gay*—about all that remains of the original Smithsonian exhibit—than by mushroom clouds on high school football helmets. Whatever we believe about the necessity of the decision to use the bomb, Americans at least deserve the opportunity to hear the contending voices and arguments. We deserve at least the chance to reflect upon it. ■

PAUL ROGAT LOEB is the author of *Nuclear Culture: Living and Working in the World's Largest Atomic Complex* (New Society Publishers, 1986), *Hope in Hard Times* (Lexington Books, 1986) and, most recently, *Generation at the Crossroads: Apathy and Action on the American Campus* (Rutgers University Press, 1994).

The legacy of the decision to drop the bomb is no more explained by the mute fuselage of the *Enola Gay*—about all that remains of the original Smithsonian exhibit—than by mushroom clouds on high-school football helmets.

The Bomb in Pop Culture

Nuclear weapons have become a screen onto which we have projected some of our deepest conflicts—as an endless stream of “escapist” books and movies shows.

BY BRYAN C. TAYLOR

ALTHOUGH the bomb has been an enduring feature of postwar culture, most Americans have never encountered it directly. Nuclear weapons are manufactured and deployed under the strictest secrecy. They are controlled by experts using technical language and complex reasoning. And the sheer anxiety that such weapons inspire inhibits most citizens from even wanting to learn about them.

But even if we have not deliberately sought information on the bomb, we have not stopped thinking about it, and popular culture reflects that. Television programs, mass-marketed fiction, and Hollywood films have repeatedly focused on nuclear weapons. In fact, argues the philosopher Jacques Derrida, it could not have been any other way. Because full-scale nuclear war has not happened, and could not be recorded if it did, stories of the bomb are mostly all that we have—symbols without a “real” referent (we keep hoping). Looking back on these cultural artifacts, we can see the shock, fantasy, regret, denial, and resolve of society as it has struggled with the possibility of nuclear destruction.

That struggle has been going on longer than most Americans might think: extensive storytelling actually anticipated the development of nuclear weapons. Historian Spencer Weart has detailed how early twentieth-century audiences incorporated the discovery of radioactivity into the pre-existing cultural myth of alchemy. Americans were fascinated and horrified by the way in which matter could, through its own destruction, be converted into this strange kind of energy, and they harbored similar feelings toward the scientific elites who possessed such powerful, forbidden secrets. While popular writers of the period conjured utopian visions of inexpensive and unlimited power generated by nuclear fission, entrepreneurs exploited the primordial association between energy rays and sexuality, marketing radioactive tonics for fatigue, baldness, and impotence. But underneath this enthusiasm lay fear. H.G. Wells imagined global nuclear war in his 1914 novel *The World Set Free*, and apocalyptic visionaries of all stripes quickly took up nuclear energy as a potential cause of The End.

The 1945 atomic bombings only heightened the



conflict, creating an outburst of both jubilation and anxiety. The bomb decisively concluded a long and bitter war, but according to Weart, it also disrupted “the delicate balance by which people in normal times manage to live with the knowledge of their mortality.” It was not simply the scale of damage at Hiroshima

and Nagasaki that produced this dread; indeed, as defenders of the bomb argued, the firebombings of Dresden and Tokyo produced a greater level of devastation. Rather, what disturbed people was the frightening efficiency of destruction inherent in nuclear-weapons technology—the ability to wipe out whole cities in an instant. As philosophers and religious leaders debated the implications of nuclear weapons—and as defense analysts both predicted their development by other governments and acknowledged the impossibility of defending against them—the nation shuddered.

Eruptions of Fear

The mass media quickly moved to assist Americans in assimilating the bomb, and nuclear technology in general, as a necessary, positive, and “natural” presence. The propagandistic tone of what emerged suggests that government interests had an influence as well. William Laurence of the *New York Times*, for example, described nuclear weapons and test explosions in mythical and supernatural terms—as awesome, “titanic” forces from “the heavens” reflecting “the power of the Almighty”; such descriptions deflected questions about human responsibility that might have leaped out at readers if the writing had been more matter of fact. Curious moviegoers were treated to a spate of melodramatic, pseudo-documentary reenactments of the top-secret Manhattan Project, including *The Beginning or the End*, which featured a young scientist who resolves his moral doubts about working on the bomb through patriotic rationalizations.

As historian Paul Boyer has argued, the campaign to normalize nuclear weapons was not entirely successful, however. The decade between 1953 and 1963 saw an outpouring of works that were anything but reassuring. Writers and filmmakers not wholly preoccupied with reaching a mass audience recovered their artistic voices to evoke the existential dread of post-

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nuclear contamination, as reflected in the novel *On the Beach* and the film of the same name. Popular culture also carried nuclear-psychological freight. Susan Sontag has observed that the “radiated monster” films of this period, such as *The Beast from 20,000 Fathoms*, reflected the public’s anxiety about the biological effects of ionizing radiation, the monsters functioning as symbols of a mutated postnuclear humanity. Ironically, these films often showed the monsters created by radiation finally being defeated with nuclear weapons. It was as if the symbolic eruptions of nuclear fear could be disciplined only by the technology that had caused them in the first place.

The surge of nightmarish images declined temporarily after the 1963 signing of the atmospheric test-ban treaty. Antinuclear sentiment, like nuclear testing itself, went underground—only to resurface in the early 1980s in reaction to renewed Cold War tensions during Ronald Reagan’s first term. Literature such as Jonathan Schell’s *The Fate of the Earth*, television dramas such as *The Day After*, and films such as *Testament* aimed to frighten people into opposing the arms race by depicting a desperate, bleak, and violent postnuclear landscape.

Yet not all pop-culture genres appeared to dread the prospect of such a world. Macho pulp-fiction series like *The Survivalist* portrayed bands of hard men roaming the same landscape and recovering the Cold War, armed combat, and primitive heterosexuality from the ashes of feminism and the liberal welfare state. This fantastic denial of postnuclear realities, argue critics such as William Chaloupka, Robert Mielke, and James William Gibson, reflected the insecurity of the American male warrior—whose traditional battlefield heroism had been supplanted by nuclear weapons.

Still other kinds of works have arrived on the scene since 1989, when the apparent end of the Cold War confused both American foreign policy and popular culture. An emerging impulse toward seeing nuclear history in new ways was displayed in the 1989 film *Fat Man and Little Boy*, which showed Manhattan Project officials at odds with the nuclear scientists in their employ, suppressing ethical dissent among them to produce a weapon whose military effect was redundant. At the same time, ambivalence about the possibility of national security without nuclear weapons was manifested in the 1989 film *The Package*, in which renegade U.S. and Soviet military officers conspire to prevent the signing of an arms-control treaty because they are certain that it will lead to conventional warfare between their nations.

In more recent years, films and novels with scenarios based on destabilized post-Cold War politics have become popular. These newly fashionable thrillers center on the theft of nuclear materials and weapons by various ethnic, nationalist, and separatist groups. The result is either nuclear terrorism and blackmail, as in Steven Seagal’s *Under Siege* and Tom Clancy’s *Ops Center*, or an accidental or unauthorized use of nuclear might that threatens the fragile post-Cold War peace, as in *Crimson Tide*.



Films such as *Dr. Strangelove* (top, 1963) and *Them* (middle, 1954), as well as everyday items such as this sewing kit (bottom), reflected the nation’s profound ambivalence about the atomic era.

As the post-Cold War world evolves, spawning new concerns, we can count on nuclear popular culture to evolve with it, mirroring those concerns in works that feel both timely and familiar, stocked with predictably heroic characters and well-worn plot devices. If we have made peace with nuclear weapons, it is an uneasy peace at best. The bomb is, in Weart’s words, “a symbol for the worst of modernity,” and for just that reason it will continue to form a screen onto which we project our assorted and ever-changing conflicts. ■

BRYAN C. TAYLOR, associate professor of communication at the University of Colorado, is working on a book about films and novels of the Manhattan Project.

"Nothing Natural Could Have Caused This"

The atomic veterans learned about the bomb's long-term effects the hard way, and received little recognition or support from those they had loyally served.

CAROLE GALLAGHER

THE dawn of the nuclear age also heralded the birth of a new type of veteran. Untold thousands of military veterans as well as citizens have been damaged or killed by their involvement in the aftermath of the Hiroshima and Nagasaki bombings, by their exposure to the 23 nuclear tests conducted in the Marshall Islands between 1946 and 1958, and by the 126 U.S. atmospheric tests and 1,000 underground nuclear explosions detonated in Nevada.

For the most part, the radioactive isotopes ingested or inhaled by soldiers during their service on the nuclear battlefield were not measured. The particles of radiation lodged within the bodies of these exposed individuals can cause cancer: leukemia in a few years, or solid tumors later on. Depending on where the particles are located, they can also cause other types of severe and prolonged damage to any and all organs or physiological systems, such as the cardiovascular and immune systems. The people who have suffered such effects are the undecorated casualties of an undeclared nuclear war. And their stories are vital to our understanding of the destruction these weapons unleashed upon the world.

Al Maxwell was a Marine who endured the Bataan Death March and was then held in a concentration camp near Hiroshima as a prisoner of war. The Marines used him as part of a cleanup brigade immediately after that city was destroyed by the atomic bomb. Al Maxwell's widow, Jackie, recalled from his diary that her husband and his fellow POWs "saw the mushroom cloud facing them, and he said he couldn't imagine what in the world it was. Later they had a terrible storm, and it was all black. So what was it? The black rain. [Radioactive debris from the atomic bomb was sucked up into an approaching storm front and concentrated in drops of black rain which then fell over Japan.] They knew something terrible was happening. They did an awful lot of cleanup of debris and in his diary he said, 'I can't believe this devastation here. Nothing natural could have caused this.' They worked from dawn to dusk. They laid down to rest and got this gray dust all over them. He had a rash from that time on until the end



of his life. Doctors never knew what it was. It would swell up like you had put a waffle iron on it, so high it would look like it was going to burst."

I knew Al and Jackie Maxwell for about five years while they were in and out of hospitals seeking treatment for Al's multiple myeloma, a cancer of the bone marrow. He was usually too weak to speak up, but Jackie had her say. Her energy was born of rage against the Veterans Administration, which refused Al any compensation for service-connected disabilities because, according to government records, he had never been in Hiroshima. Other Marines in the Hiroshima and Nagasaki Occupation Forces were treated to similar indignity and denial. "I've got the letters from them to prove they were calling him a liar. I wanted him vindicated. Out of those 24 guys [from the POW camp] that were exposed with him, 18 of them died of multiple myeloma."

Long before Al Maxwell's cancer was diagnosed, his family suffered from the effects of his exposure to radiation: four of his five children died in early childhood from birth defects. One cannot say unequivocally that the Hiroshima bomb caused these youngsters' deaths because the Maxwells made their home downwind of the Nevada Test Site in Utah, where they were exposed to the fallout clouds from 126 atomic bombs detonated in the open air from 1951 to 1963.

Reason Warehime lived in Nagasaki for months as a Marine in the Occupation Forces. He worked, ate, and slept in radioactive dust because dust was all that was left. "It was leveled. We were camped by what was left of the railroad station—you could tell because it had all those tracks coming in. The Marine Corps engineers were cleaning up with bulldozers. Of course, all that dust didn't bother us one bit. We'd wake up in the morning with dust on us a quarter-inch thick."

Eight years later Warehime was assigned to Camp Desert Rock, where he participated in the 43-kiloton nuclear detonation codenamed 'Simon' in 1953. The exploded device was some two and a half times the size of the bomb that destroyed Hiroshima. "When the thing went off you felt you were in a vapor, like a vacuum. Everything was still as death. And then this real bright light for a few seconds—so bright I had my hands over my eyes closed, and I could see all these bones like you were looking at an x-ray. Then this

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earthquake. Everything is so dusty you can't see a thing, and a deafening roar which feels like someone crushing your head.

"The fireball was right straight up above our heads, I mean *right* over our heads. To see that fireball you had to put your head back to look up. We had to be in the stem of it. I told my men to get out of the trench and move out. Our sandbags were all on fire, and I had a sack lunch sitting up there that burned down to a piece of charcoal. We went straight forward, which put us in really high radiation. We noticed when you get out closer that a lot of the sand had kind of melted into a glaze, like a brown glass.

"Then we got a sunburn [*actually, burns from the bomb's beta particle radiation*] and the guys all started throwing up in the truck going back, sick as dogs, all of them."

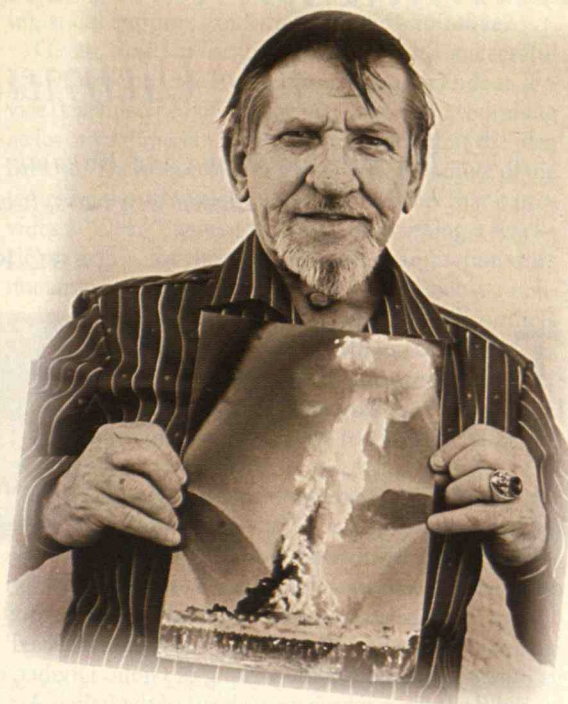
The fallout cloud from Simon was still dangerous when the prevailing winds carried it to New York State, where it rained out over local dairy farms during a thunderstorm. At Rensselaer Polytechnic Institute in Troy, students noticed laboratory Geiger counters clicking when they came to class. The puddles outside were radioactive and the radiation count for tap water was 2,630 times higher than normal. Data regarding the rainout were quickly classified, but it was neither the first nor the last time that high levels of fallout would visit the East.

Meanwhile, some weeks after the test, Reason Warehime began to lose his hair. "It started every time you put your comb through your hair, you come out with a big gob of hair. It would have been three years later when they finally had to pull every tooth in my mouth because they had all turned black and came real loose. Let's face it, I was 28 and that's not the time you lose all your teeth all of a sudden. And I was sterile after the shot. That's in my military records."

By the time he reached his thirties, Warehime had developed cataracts, osteoporosis, and muscle deterioration. In 1982, a malignant tumor was discovered in his lung.

The voice of Ted Przygucki has long been silenced by cancer of the larynx, but not his story. He has seen far too much for that, having witnessed the detonation of 22 atomic bombs between 1952 and 1956. As the Army truck master of Survival City at the Nevada Test Site—construction by the Atomic Energy Commission of fake homes, hotels, and streets dubbed "doomtown" by the agency and the local press—he saw mannequins and animals all "burned to a crisp."

"If they would have come out and said that it would hurt you in the years to come, I would have gone AWOL. The AEC and the Department of Defense, they have been dodging the public for so damn long that people are just fed up with their silly tales of 'it's impossible,' 'nothing will happen,' and 'it is safe.' The main object was to see how our troops would react in case, in a war, our enemies dropped an A-bomb on us, what type of injuries we would receive, or burns, but never internal radiation. Veterans told me that when they go for a checkup at the VA, and they tell



them they are atomic veterans, they just give them a normal physical, then they call in a psychologist to try to talk them out of the idea that they are sick. I wouldn't trust them. They'd just tell me I was wacky. When I told them I was exposed to radiation, it was 'so what.'"

Throughout the past decade, when I interviewed and photographed hundreds of people like Al Maxwell, Reason Warehime, and Ted Przygucki, as well as test-site workers and those so unfortunate as to live downwind of the Nevada Test Site, I noticed that the Americans affected by our secret nuclear war were a diverse group, but they all had two things in common: patriotism and passivity. Their faith in government would seem foolish by today's standards of cynicism, but it is a poignant reminder of the trust we once had in each other as fellow citizens, justified or otherwise.

Unfortunately, on the fiftieth anniversary of the Hiroshima and Nagasaki bombings, Americans seem incapable of much self-evaluation, preferring to avert their eyes and deny responsibility. The furor and ultimate censorship of the Smithsonian's Enola Gay exhibit is not an isolated incident. Others seeking to reexamine this difficult material publicly have also been stifled, myself included. A traveling exhibition of my work, organized by the International Center of Photography in New York, has been canceled by two federally funded museums since the Smithsonian Institution's *Enola Gay* controversy. But, like Ted Przygucki's story, the message of the atomic veterans will not easily be silenced. After a half-century of concealment, the American people deserve and need the opportunity to look in the mirror and face this difficult legacy. ■

CAROLE GALLAGHER is the author of *American Ground Zero: The Secret Nuclear War* (MIT Press, 1993).

Ted Przygucki says that when atomic veterans go for checkups at the Veterans Administration, health workers "call in a psychologist to try to talk [us] out of the idea that [we] are sick."

The Ultimate Bombing

Just when Hiroshima and Nagasaki showed that strategic bombing could indeed win wars, it ceased to be an option.

CARL KAYSEN

THE two atomic bombs that the U. S. Army Air Force dropped on Hiroshima and Nagasaki marked the climax of the idea of strategic bombing as an all-powerful mode of war. Victory through air power alone at last seemed achievable.

The idea of strategic bombing—as opposed to tactical bombing, which complements but does not replace ground combat—had its origins during and after the first World War. The notion received its purest expression in the writing of Giulio Douhet, an artillery officer who became head of the Italian Air Force. In his book *The Command of the Air*, Douhet emphasized the goal of destroying opponents' will and overall capability by bombarding their centers of power—essentially their cities—from the air. During World War II, the Army Air Force (USAAF), in its explorations of how to use strategic air power, placed more emphasis on the bottleneck theory of target selection: the idea was to destroy key industrial sites to deprive opponents of their capacity to produce essential weapons and supplies, and thus broadly impair their fighting ability.

The European theater of that war saw these two different theories of strategic bombing exemplified in the operations of the British Royal Air Force and the USAAF. The RAF area-bombed German cities at night for nearly three years on the theory that the destruction of workers' housing and general dis-

organization of urban life would lower morale and productivity enough to affect German war production. And the USAAF, in contrast, bombed industrial targets by day, concentrating first on those connected with the production of fighter aircraft, and later on oil refineries and synthetic

oil plants supplying the military with fuel for both air and ground operations.



There is no evidence that the RAF area bombing had any significant military or political impact. The USAAF attacks were comparatively more effective, but their limitations (such as the inability to bomb accurately through the frequent cloud cover of Northwest Europe) were severe, and overall success was modest. The most

important result of American operations was the heavy attrition of the German Air Force, which gave the Allies complete command of the air for the Normandy invasion and the battle for Western Europe that followed. The bombing also diminished the mobility of Germany's field forces, especially in Western Europe, by reducing the country's production of liquid fuels.

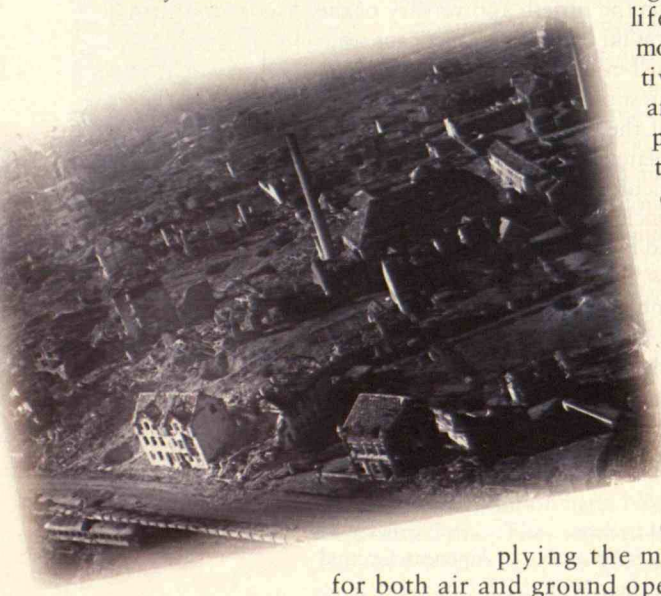
In the Far East, U.S. strategic bombing against Japan in the last year of the war—an effort conducted more on the British than the American model—was much more destructive, owing to the combustibility of Japanese cities. Its effects on Japanese fighting capacity, however, were confounded with those of the increasingly tight naval blockade, in which submarines, surface ships, and air-sown mines all played a part. World War II thus showed that while strategic bombing with conventional weaponry contributed to the success of the military effort, it certainly couldn't win the war singlehandedly.

Enter nuclear weapons. Douhet's vision of the destruction of an opponent's will and capacity to fight became technologically possible. The second stage of the nuclear revolution after the war—when countries combined thermonuclear warheads of arbitrary power with accurate long-range ballistic missiles—made that possibility a certainty in the event of all-out nuclear war.

But since 1945, nuclear weapons have not been used in war. Just when the vision of strategic air power as the supreme instrument of war became feasible in principle, it became impossible in practice. One reason, of course, was the likelihood of retaliatory response in kind. But an even deeper restraint was wide abhorrence of the idea of unlimited destruction.

Thus, even when nations possessing vast numbers of nuclear armaments encountered difficult combat situations with little possibility of retaliation—the United States in Korea and Vietnam, the Soviet Union in Afghanistan—no political leader authorized the use of nuclear weapons. While the exigencies of World War II (as seen by the leading participants) eroded the moral constraints on the deliberate attack of noncombatants, the advent of the potential for limitless

The U.S. bombing of oil refineries and manufacturing plants during World War II diminished the mobility of Germany's field forces and helped give the Allies command of the air for the Normandy invasion.



destruction appears to have restored them.

Despite this development, leaders of the U.S. Air Force continue to hold onto the idea of the ultimate power of stand-alone strategic bombing. While they have come to recognize, or at least to say in public, that strategic nuclear forces are useful only for deterrence, they believe that precision-guided weapons now make decisive strategic bombing with conventional bombs and warheads both possible and politically acceptable. Yet nothing in the experience of the wars in Korea, Vietnam, and Iraq justifies that belief.

In the first two cases, there is no evidence that attacks on cities, power stations, and ports significantly affected the North Korean or North Vietnamese will or capacity to fight. In Iraq, strategic attacks contributed to the overwhelming superiority of U.S.-led coalition forces. However, the war was won not by wide destruction of power plants or other large-scale facilities in and around Baghdad, but by ground armies supported by massive tactical air power effectively directed against the Iraqi ground forces, their

logistical support, and their capacity to move.

Given that the origin (in 1947) and successful growth of the U.S. Air Force as an independent service depended heavily on the idea of strategic bombing as its central mission, it is not surprising that the idea lives on. The notion also has wide appeal because of the tempting though usually unexamined belief that it provides a "clean" way of fighting and winning a war—clean, that is, for the attackers. But examination does not sustain that notion, either for a war against a militarily capable adversary or for the kinds of conflicts involving irregular forces and armed bands now raging in many parts of the world. Strategic bombing as the supreme mode of war has proved to be either ineffective or too frighteningly effective to be usable. ■

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Keep the Bomb

The hundreds of thousands of lives lost at Hiroshima and Nagasaki must be weighed against the hundreds of millions of lives saved by the existence of nuclear weapons.

ALEX ROLAND

A Marine Corps major in the late 1970s decorated the door of his office at the Pentagon with a poster trumpeting "Ban the Bomb!" Barely visible at the bottom margin was the riposte: "Make the World Safe for Conventional War."

The poster was intended to be funny. Its premise, however, is not. With the world's major military powers paralyzed in a nuclear balance of terror, conventional war between them—the large-scale, mechanized, resource-intensive campaigning made familiar by the two world wars—has become unthinkable, lest it escalate into nuclear war. The result has been a far more peaceful world over the last 50 years than the one that surely would have existed without nuclear weapons. They have done more good than harm in the world.

Those of us who lived through the Cold War are not accustomed to thinking of nuclear weapons in these terms. Especially in the 1950s, when the insanity of the Cold War was at its peak, just the opposite seemed likely. Atmospheric testing of nuclear weapons poisoned the air. Krushchev threatened to bury us. In response, we prepared to bury ourselves in bomb shelters. The besetting question about



nuclear war was not if, but when.

And the danger was real. At the climax of the Cold War, during the Cuban Missile Crisis of 1962, the superpowers came closer than ever before or since to unleashing their nuclear arsenals.

To those who formed their opinions about nuclear weapons during this early and dangerous era, nuclear weapons seemed likely to kill more people than any other technology in human history. Happily, such a cataclysm has never occurred. Instead, consider how many deaths have been prevented by nuclear weapons. An ever-growing body of evidence suggests that the number of people whose lives have been saved by nuclear weapons reaches into the hundreds of millions.

Through most of human history, death in war has been constant, horrible, and scant. Harvard sociologist Pitirim Sorokin estimated that war casualties in the Roman empire ranged from .07 percent to .36 percent of the empire's population. By comparison, the Soviet Union lost an estimated 14 percent of its population in World War II.

The reason that ancient warfare did not wipe out more people was not human kindness but limited technology. Killing was simply a labor-intensive enter-

HAD THERE BEEN CONVENTIONAL WAR IN THE SECOND HALF OF THE TWENTIETH CENTURY ON THE SCALE SEEN IN THE FIRST HALF, WE COULD HAVE EXPECTED WAR DEATHS EXCEEDING THOSE IN THE TWO WORLD WARS COMBINED.

prise. Virtually all deaths in combat came from sword stroke, spear thrust, or the discharge of some muscle-powered missile. Fights to the death were the exception rather than the rule. Armies losing ground in an engagement would more often flee than fight; victors seldom had the energy or the will to hunt them down. Even in naval warfare, where the sinking of a ship held out promise of mass casualties, most battles were decided by boarding, hand-to-hand combat, and the capture of prisoners. Humans were surely bloody in tooth and claw, but their reach was limited.

Two revolutions broke through this ceiling. The

The first half of the century and the world wars that scarred it may be seen as the culmination of the gunpowder and industrial revolutions.

But after the midcentury mark, things change. According to Sivard's calculations, 84 percent of the casualties from war in this century occurred before 1950. Moreover, the ratio of casualties to world population is now decreasing. By the latter measure, the rate of war-related deaths in the second half of the twentieth century is one-tenth that in the first half, lower than in the second half of the nineteenth century, and almost as low as in the first half of the nineteenth century.

The world has not been this safe since 1850. And the peace holds. The so-called proxy wars, in which the superpowers armed and aided the protagonists—Korea, Vietnam, Angola—have subsided. Certainly conventional armed conflict has persisted in the form of the Falklands War, the Iran-Iraq War, the Gulf War, and the war in Bosnia, but these remain localized conflicts with relatively limited casualties. It is hard to imagine an approaching cataclysm on the trajectory set up by the Napoleonic Wars, our Civil War, and the two world wars.

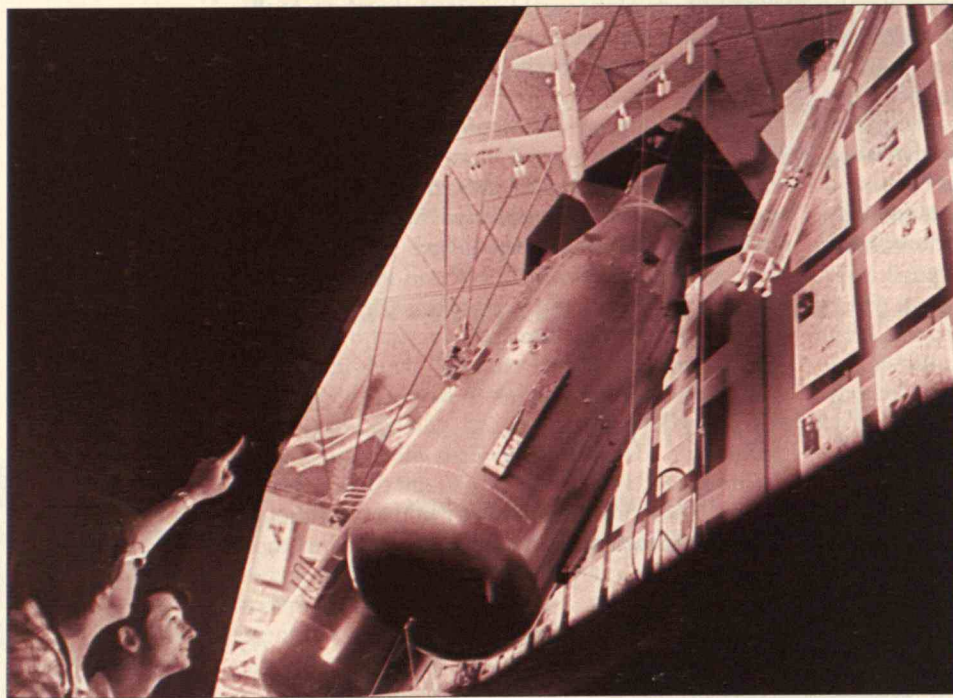
Had there been conventional war in the second half of the twentieth century on the scale seen in the first half, we could have expected more war deaths than occurred throughout recorded history up to the twentieth century—and more than piled up in the two world wars combined. Extrapolating from Sivard's

figures, we can reasonably project that another world war, say in the decade of the 1980s, could have killed 250 million people—5 percent of the world population—even if the combatants used only conventional weapons.

Since Sivard calculates that some 17 million people died in war between 1949 and 1990, we might conclude that more than 230 million people have been spared from the trajectory of death laid out by the Industrial Revolution and the world wars. Those people lived because of nuclear weapons.

With the advent of nuclear weapons, humans finally succeeded in devising an instrument of war so terrible that other means had to be found to settle political conflicts. Surely there has been no lack of conflict. Surely man's inhumanity to man is still a potent force in world affairs. Surely the United Nations and other institutions of collective security have proven ineffective. Yet the fear of conflict in many cases has become more powerful than the forces of conflict themselves.

Throughout the seventeenth, eighteenth and nineteenth centuries, visionaries as disparate as John Donne and Robert Fulton hoped that cannons, ships, and other artifacts of humanity's triumph over nature



With the advent of nuclear weapons, humans finally succeeded in devising an instrument of war so terrible that other means had to be found to settle political conflicts.

invention of gunpowder in the late Middle Ages allowed soldiers and sailors to kill their enemies at greater distance and in greater numbers. In her book *World Military and Social Expenditures*, Ruth Sivard, former chief of the economics division of the U.S. Arms Control and Disarmament Agency, has compared global war casualties over the past five centuries. Her research shows that with the aid of gunpowder, worldwide deaths in warfare quadrupled from an estimated 1.5 million during the sixteenth century to 6.2 million during the seventeenth.

Worse still, the Industrial Revolution mechanized warfare, further expanding its reach. Vast quantities of weapons could now be produced to supply armies of unprecedented size. Inventions such as the steamboat, railroad, and telegraph allowed those armies to be transported around the globe, resupplied for indefinite campaigns, and directed from afar in their grisly business. According to Sivard, global deaths caused by war increased from 6.4 million during the eighteenth century to 20 million in the nineteenth.

And the power to kill has continued to grow exponentially. The twentieth century has the grim distinction of being the most deadly in human history, with approximately 103 million war-related deaths so far.

would make war too horrible to pursue. But only in the desert of New Mexico, in the summer of 1945, did the scientists and engineers of the Manhattan Project finally realize that goal. J. Robert Oppenheimer looked at the result of their labors and feared, "Now I have become death." For the victims of Hiroshima and Nagasaki, his fears proved true enough. But the legacy of that bomb has been life for hundreds of millions of people.

What reason is there to think that, in the absence of these terrible weapons, there would have been conventional war on such a massive scale? At no time in human history have two major powers, divided by ideology and ambition and united by proximity and conflicting interests, resisted the temptation to settle their differences on the battlefield. The rhetoric of the Cold War, and the huge conventional military forces amassed by both sides, give every reason to suspect that without nuclear weapons there would have been a World War III by now. Perhaps it would have come during one of the Berlin crises, or the Korean or Vietnam wars, or one of the countless other confrontations between East and West. But come it would have.

Still, it may be argued, the success of nuclear weapons in preventing World War III is hardly grounds for believing that these horrendous instruments have not posed—and do not still pose—a threat to humanity that entirely outweighs the fragile peace they have so far forced upon us. What about proliferation? What about the possibility of terrorists brandishing these weapons on the world stage? What about the argument of Admiral Noel Gaylor (a cold warrior turned peace activist) that these weapons, like all others in human history, will be used eventually—and with results that will obliterate the transient gains of the last 40 years?

Predictions of the imminent use of nuclear weapons have been made since 1946, and all have proven false.

The darkest forecasts accompanied China's acquisition of nuclear weapons in the 1960s. But Mao and his successors have been true to their promise to use nuclear weapons only to ensure that China would not be attacked. Indeed, unlike the other major powers, China does not rattle the nuclear sabre.

Six to twelve nations now possess nuclear weapons, and the technology is within the reach of many more states and even some terrorist groups. Yet none have used them; most have foregone even developing them. The record grows stronger every year.

And what if nuclear weapons were to be used again? What if, for example, India and Pakistan—widely regarded as having nuclear weapons or the capacity to acquire them—drove each other, *in extremis*, to push the button? The casualties would surely be horrendous, but they would amount to only a fraction of the number that would have been killed by now without nuclear weapons.

The argument made here is not new. Historian Bruce Mazlish made a similar case in the 1960s; so have political scientists Kenneth Waltz and John Mearsheimer. But all of them wrote during the Cold War, too close to the event for their ideas to win broad acceptance.

Now the Cold War is over. What it has wrought may finally be viewed without the passions bred by fear. The great bloodletting engendered by the Industrial Revolution has peaked. We need to acknowledge this blessing and preserve the relative peace that it has brought—even if the price of peace is to live in apprehension, even dread, of our own capabilities for destruction.

Keep the bomb. Save the world from conventional war. ■

ALEX ROLAND, a professor of history at Duke University, teaches military history and the history of technology.

Five Lessons from the Cold War

The strategy of deterrence had some value, but it also fostered behavior and attitudes that kept the superpowers on the brink of war.

RICHARD NED LEBOW AND JANICE GROSS STEIN

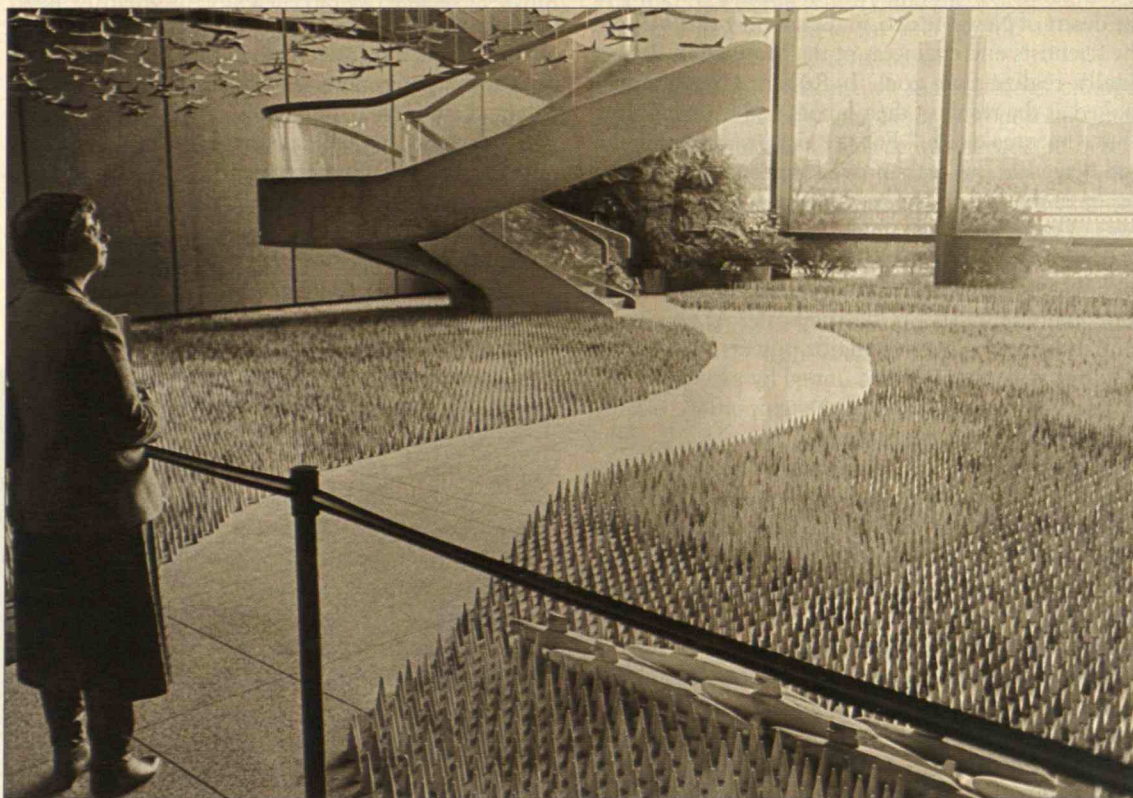
MANY politicians, generals, and academic strategists assert that the U.S. nuclear arsenal restrained the Soviet Union throughout the Cold War. In reality, the strategy of deterrence was self-defeating; it provoked the kind of behavior it was designed to prevent.

Leaders on both sides recognized that only a madman would use nuclear weapons against a nuclear adversary. They therefore tried, and to a disturbing degree succeeded in, con-



vincing the other that they might be sufficiently out of control to implement their threats. Each consequently became less secure, more threatened, and less confident of the robust reality of deterrence. While fear of nuclear war made leaders inwardly cautious, their public posturing convinced their adversaries that they were aggressive, risk-prone, and even irrational.

Newly declassified documents and extensive interviews with Soviet and U.S. officials have permit-



A 1985 exhibit entitled "Amber Waves of Grain," installed at Boston's Museum of Science, depicted some 25,000 warheads in the U.S. nuclear arsenal.

ted us to reconstruct the deliberations of leaders of both superpowers before, during, and after the two most serious nuclear confrontations of the last 30 years: the Cuban Missile Crisis of 1962, which led President Kennedy and Soviet Premier Khrushchev to the brink of nuclear war; and the 1973 Middle East War, where the Soviet Union's threat to intervene on behalf of Egypt led the United States to put its nuclear forces on full alert. Our evaluation of these events suggests five conclusions about the political role of nuclear weapons:

1. Attempts to exploit real or imagined nuclear advantages for political gain usually fail.

During the late 1950s and early 1960s, Khrushchev and Kennedy tried to intimidate each other with claims of strategic superiority. Both efforts backfired. Khrushchev's threats and boasts strengthened Western resolve to hold the line in Berlin and prompted Kennedy to initiate a major strategic buildup. Kennedy's threats against Cuba, his assertions of strategic superiority, and his deployment of Jupiter missiles in Turkey—all intended to dissuade Khrushchev from challenging the West in Berlin—instead convinced Khrushchev that he needed to fortify Cuba with missiles to prevent a U.S. invasion and to compensate for Soviet strategic inferiority. Both leaders were willing to risk a serious confrontation to avoid creating the impression of weakness or irresolution.

2. A threat to use nuclear weapons lacks credibility.

The destructiveness of nuclear weapons makes nuclear threats more frightening but less believable—

especially when those threats are directed against adversaries who have the capability to retaliate in kind.

During the missile crisis, for example, Khrushchev believed that Kennedy was too rational to start a nuclear war. He worried instead that foreign-policy hawks would push Kennedy into attacking Cuba with conventional forces, and that armed clashes between the invading Americans and the Soviet forces on the island committed to Cuba's defense would escalate into a wider and perhaps uncontrollable war.

In 1973, the American nuclear alert had even less influence on the Soviet leadership. Brezhnev and his advisers did not believe that the interests at stake for either the United States or the Soviet Union justified war, and concluded that the U.S. alert was an attempt to divert the U.S. public's attention from the Watergate scandal that was beginning to engulf the Nixon presidency.

3. Nuclear threats are fraught with risk.

In both 1962 and 1973, U.S. leaders were uninformed about the consequences and implications of strategic alerts. In 1973, American leaders fully understood neither the technical meaning nor the operational consequences of the "defense condition III" (DEFCON III) alert that they had ordered. They did not realize, for example, that the decision to move to DEFCON III would entail alerting U.S. nuclear forces in Europe. During the Cuban crisis, when conventional and nuclear forces were moved to an even higher level of alert, the risk of military insubordination posed a serious threat to the resolution of the crisis.

Disgruntled military officers in the Soviet Union, for example, willfully misinterpreted their orders not to fire at American airplanes or ships unless Cuba was attacked. Outraged at having to tolerate American intelligence overflights of Cuba, they shot down a U-2 reconnaissance aircraft with a surface-to-air missile. The downing of this plane and the death of its pilot was arguably the most serious moment of the crisis, prompting almost unanimous agreement among the president's military advisers that he should order a retaliatory air strike. Further attacks on American aircraft would have left him little choice but to do so.

On the American side, the most serious mishap occurred on Saturday morning, at about 10:30 Washington time. An Alaska-based U-2 operated by the Strategic Air Command strayed into Soviet air space over the Chukotski Peninsula in eastern Siberia. Soviet MiG fighter jets were scrambled from a base near Wrangel Island. When the American pilot radioed for assistance, U.S. fighter aircraft armed with low-yield, nuclear air-to-air missiles were sent to escort him home. The U-2 left Soviet air space without any shots being fired.

The confrontations of 1962 and 1973 suggest that there are stark trade-offs between the political leverage that military preparations are expected to confer and the risks of inadvertent escalation they entail. American leaders showed a poor understanding of these trade-offs: they significantly overvalued the political benefit of nuclear alerts and were insensitive to their risks.

4. Strategic buildups are more likely to provoke than to restrain adversaries.

Khrushchev thought that the West behaved cautiously in the 1950s because of a growing respect for the economic as well as military power of the socialist camp. Therefore, more visible demonstrations of Soviet power in the form of nuclear threats and missile deployments would strengthen the hands of "sober realists" in Washington who favored accommodation with the Soviet Union.

But Khrushchev's initiatives had the opposite effect: by intensifying American fears of Soviet intentions and capabilities, they strengthened the position of anti-Soviet militants. In fact, Kennedy's warnings to Khrushchev not to deploy missiles in Cuba, and the subsequent U.S. blockade, were largely a response to the growing domestic political pressures to act decisively against the Soviet Union and its Cuban ally.

Brezhnev, expecting that Soviet nuclear capabilities would prevent the United States from engaging in nuclear blackmail, continued to accumulate warheads and missiles. But U.S. officials, who had believed that the Soviet Union would stop its strategic buildup once it had achieved parity with the United States, were troubled. The Soviet strategic spending appeared to confirm the predictions of militants in Washington that Moscow's goal was strategic superiority, even a first-strike capability (that is, enough weapons to cripple in one blow the other side's retaliatory force). The Brezhnev buildup, along with the Soviet invasion of Afghanistan, helped Republicans to defeat President

Carter and the SALT II agreement, and provided the Reagan administration with justification for massive arms spending.

U.S. attempts to put pressure on the Soviet Union through arms buildups were equally counterproductive. By the time Gorbachev became general secretary in 1985, he was deeply committed to fundamental change in Soviet foreign policy and determined to overhaul an economy crippled by defense spending and, more importantly, by structural rigidities. Gorbachev felt free to propose deep cuts in nuclear weapons because he was confident that the United States would not attack the Soviet Union. Because he saw no threat of a U.S. attack, Gorbachev was not intimidated by the Reagan administration's military program. Alexandr Yakovlev, one of Gorbachev's closest advisers, insists that Reagan's commitment to the Strategic Defense Initiative only made it more difficult for Gorbachev to persuade his officials that arms control and an end to the Cold War was in the Soviet interest. The Cold War ended in spite of Ronald Reagan's arms buildup, not because of it.

5. Nuclear deterrence is robust when leaders on both sides fear war and are aware of each other's fears.

More important than the balance of nuclear capabilities, or leaders' estimates of relative nuclear advantage, is their judgment of an adversary's intentions. The Cuban Missile Crisis was a turning point in Soviet-American relations because it convinced Kennedy and Khrushchev that their adversary was just as committed as they were to avoiding nuclear war. This mutually acknowledged fear of war made the other side's nuclear capabilities less threatening and paved the way for arms-control agreements.

Not all U.S. and Soviet leaders shared this interpretation. Large segments of the national security elites of both superpowers continued to regard their adversary as implacably hostile and willing to use nuclear weapons.

Brezhnev and Nixon both cited the need to deter enemy attack to justify continuing buildups in their countries' strategic forces. Western militants did not begin to change their estimate of Soviet intentions until Gorbachev made clear his commitment to ending the arms race and the Cold War.

Deterrence in Hindsight

The Cold War began as Soviet-American competition in Central Europe in the aftermath of Germany's defeat. Once recognized spheres of influence were established, however, confrontations between the

A AMERICAN AND SOVIET ATTEMPTS TO PRESSURE EACH OTHER THROUGH MASSIVE ARMS BUILDUPS WERE EQUALLY COUNTER-PRODUCTIVE, AS THEY STRENGTHENED THE HAND OF MILITANTS ON BOTH SIDES.

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superpowers in the heart of Europe diminished; even Berlin ceased to be a flashpoint once the superpowers reached an understanding about the two Germanies.

By the 1970s, the growing arsenal and ever-more-accurate weapons of mass destruction that each superpower aimed at the other had become the primary source of mutual insecurity and tension. Moscow and Washington no longer argued about the status quo in Europe but about the new weapons systems each deployed to threaten the other.

Since the late 1960s, when the Soviet Union developed an effective retaliatory arsenal, both superpowers have had to live with nuclear vulnerability. Some leaders in both countries advocated development of the ability to launch a preemptive strike, ballistic missile defense systems, or other illusory visions of security in a nuclear world. But nuclear vulnerability could not be eliminated. Mutually assured destruction was a reality from which there was no

escape short of political accommodation and far-reaching arms control.

The nuclear arms paradox resembles that often found in medicine. The same chemotherapy drugs that control cancer can also kill the patient. Arsenic, in controlled doses, can treat such diseases as syphilis and schistosomiasis. The outcome depends on the virulence of the disease, how early the disease is detected, the amount of drugs administered, and the resistance of the patient to both the disease and the cure.

So it is with nuclear deterrence. To a certain extent, deterrence is stabilizing because it prompts mutual caution. Too much deterrence, or deterrence applied inappropriately to a frightened and vulnerable adversary, can fuel an arms race that makes both sides less secure and provokes the aggression it is designed to prevent. As with any medicine, the key to successful deterrence is to administer the proper dosage. ■

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ENDING
THE REIGN OF
TERROR

A Nuclear-Weapon-Free World

It may at first sound like wishful thinking, but outlawing nuclear weapons altogether could actually produce a much more secure world than the present one.

JOSEPH ROTBLAT

THE iniquitous characteristics of nuclear weapons—enormous destructive power, indiscriminate killing of civilian populations, a legacy of death and disease in people yet unborn—make the atomic bomb repugnant to every sensible person. From the beginning there has been a nearly universal desire to get rid of it. The very first resolution of the United Nations, adopted unanimously by the General Assembly in January 1946, called for eliminating nuclear weapons. Subsequent U.N. declarations have repeated this call. The five nuclear-weapon states became legally committed to nuclear abolition when they signed the Non-Proliferation Treaty (NPT), agreeing, in Article VI, to proceed in good faith to complete nuclear disarmament. This is still their stated objective.

Clearly, a nuclear-weapon-free world is not the weird idea of a fringe group but the desired objective



of much of the global community. All the same, such an idea could not be considered seriously during the Cold War. The two superpowers were locked in a mortal, ideological struggle in which nuclear weapons played a major role. The world was polarized and the period was dominated by a relentless nuclear arms race.

Today's general state of strife and violence has made some people hanker after the "stability" of the Cold War. But there never was any stability. At no time was either side satisfied that its nuclear arsenal was sufficient to ensure its security. Each superpower felt compelled to keep improving its offensive potential and developing new defensive capabilities. As time went on the race became extremely costly, imposing unbearable economic burdens, particularly on the Soviet Union. I believe that the nuclear arms race, had it continued, would have ended in a nuclear holocaust and the destruction of our civilization. For-

tunately, a sane leader emerged: Mikhail Gorbachev, who in a very bold move—one that later contributed to his downfall—stopped the nuclear arms race.

The collapse of communism and the disintegration of the Soviet Union created an entirely new political climate: erstwhile enemies have become friends and partners. Today there is no more excuse for the nuclear powers to avoid fulfilling their obligations under Article VI of the NPT. Yet they have not embarked on a program of complete nuclear disarmament. Despite views such as that of Gen. Charles Horner, chief of the U.S. Space Command, who has said "the nuclear weapon is obsolete. I want to get rid of them all," the U.S. Pentagon's recent nuclear posture review concluded that the "Post-Cold War environment requires the nuclear deterrent." This sentiment is echoed in the policies of Russia, France, and the United Kingdom.

The main argument advanced by the nuclear states as an excuse for retaining their weapons is the so-called "breakout" syndrome. According to this view, the genie is out of the bottle. Nuclear weapons cannot be disinvented; knowledge about them cannot be expunged. Therefore, this line of reasoning asserts, even if nations agreed to get rid of all nuclear weapons, a rogue state could still build a new nuclear arsenal at some time in the future. That state could then blackmail other countries, perhaps the whole world.

The fallacy of the disinvention argument is that it ignores ways by which a civilized society deals with undesirable products of technological advance: through the application of law—in this case by making the acquisition of nuclear weapons an illegal act punishable under international law. In putting forward their argument, the nuclear states have assumed, without supporting evidence, that a treaty to eliminate nuclear weapons would not be effective in preventing breakout.

The prevention of breakout is admittedly a serious problem that troubles even political and military leaders who want to get rid of nuclear weapons. For example, former Secretary of Defense Robert McNamara has said, "I strongly advocate a return, by all nuclear powers, insofar as practicable, to a non-nuclear world"—his qualification referring to the necessity of maintaining protection against breakout. But a recent study of this problem by Pugwash, an international group of scientists who meet regularly to address security issues and other global concerns, concluded that preventing breakout, while not easy, is possible with the aid of two verification systems: one technological and the other social/political.

Some two to three decades will be needed to put into place the technological elements of the necessary safeguard system, including dismantling all warheads under international control, disposing of highly enriched uranium and plutonium, and establishing much more stringent supervision over the various processes involved in the peaceful use of nuclear energy.

Time will also be needed to introduce the necessary social and political changes, some of which contain an element of public education. One such innovation is the acceptance of the universal validity of a

treaty to abolish nuclear weapons. Once a certain number of states—including the present nuclear states—have agreed to such a treaty, a resolution of the Security Council can make it binding on all states without exception. The treaty would make the possession of nuclear weapons a criminal offense, with any transgression punishable by the United Nations under international law.



An important feature of the treaty to eliminate nuclear weapons will be a clause that mandates all states to pass laws making it the right and duty of every citizen to notify an international authority of any suspected attempt to violate the treaty. This will make every citizen—each of us—the treaty's custodian. The scientific community will play a special role in monitoring the activities of scientists and the purchase of specialized equipment for making nuclear weapons. Whistleblowing will be encouraged and immunity will have to be assured.

With these two verification systems, technological and social/political, the probability of undetected nuclear proliferation will be vanishingly small. This system is not absolutely foolproof; there can be no 100 percent guarantee that breakout will not occur. But the likelihood of such an occurrence will be much less than it is at present, when we face an abundance of nuclear weapons.

Who is likely to violate the treaty? Not a state governed by rational leaders, because they will realize that any advantage gained from the acquisition of a few bombs would be transient, and very costly in view of the severe retribution by the family of nations. Of course, this argument does not apply to a fanatical leader or to a group of terrorists, but such a danger exists now. Should a terrorist group acquire an atomic bomb, place it somewhere in a city, and then demand a ransom, all the thousands of nuclear warheads in the world's arsenals will be useless to deal with the threat. However, such an event is much more likely to occur now, when there are so many nuclear weapons and the materials to make them are available in a developing black market, than in a world in which there are no nuclear weapons.

Secretary of

Energy Hazel R. O'Leary (center) stands with whistleblowers who reported health and safety violations in the nation's nuclear-weapon complex. A treaty outlawing atomic bombs would similarly rely on scientists to notify international authorities of illegal research.



Thus, while a nuclear-weapon-free world will not be absolutely safe against a nuclear threat, it will be safer than the present world, and much safer than the world we are likely to have in the next 20 to 30 years if the nuclear powers refuse to take definite steps to eliminate these weapons. This is so because the long-term alternative to a nuclear-weapon-free world is not the present world but a world where a large number of states have accepted the argument—now used

by the nuclear states—that any nation that feels threatened in any way is entitled to its own nuclear deterrent.

The lesson from 50 years of the nuclear age is that nuclear weapons are not needed for world security; indeed, they are a menace to world peace. A nuclear-weapon-free world is both desirable and feasible; only political will is needed to make it a reality. ■

JOSEPH ROTBLAT, *emeritus professor of physics at the University of London, worked on the Manhattan Project. He now serves as president of the Pugwash Conferences on Science and World Affairs, founded by members of the scientific community in 1957 in response to the threat posed by nuclear weapons.*

A developing black market for plutonium and other bomb-grade material means that terrorist groups are more likely to acquire them today than if the world pursued a ban on nuclear weapons.

The Road to Zero

The effort to rid the world of nuclear weapons must consist of a series of well-designed interim goals, each desirable and achievable in its own right.

JONATHAN DEAN AND RANDALL FORSBERG

DESPITE two decades of arms reduction, the world's nuclear arsenals are still huge. Complete abolition of nuclear weapons may remain unattainable until there is an effective world security system and a completely dependable system for detecting concealed nuclear weapons and weapon-making capability. But a series of steps pursued over the next 10 to 15 years could sharply reduce any danger of nuclear war and facilitate the final elimination of nuclear weapons.

STEP ONE: Make nuclear cuts irreversible

The Strategic Arms Reduction Treaty (START I), which went into effect in December 1994, and START II, which has not yet been ratified, would leave the United States and Russia each with more than 3,000 strategic nuclear warheads. Thousands of warheads withdrawn from deployment are not being dismantled but stored. And even when warheads are dismantled, their fissile material is simply stockpiled. If not changed, this situation would permit rapid expansion of the arsenals in the future.

To neutralize the threat that this material still poses, the United States and Russia should first:

- Establish a comprehensive system of joint bilateral monitoring to keep track of all U.S. and Russian stocks of warheads and fissile materials, as well as plants where nuclear weapons are assembled and dismantled. Monitors would not have to know details of what is at each site; they would simply ensure that nothing is added to or withdrawn without authorization.
- Dismantle all withdrawn warheads.



➤ Transfer the fissile content of these warheads to bilaterally or internationally monitored storage.

➤ Cease production of fissile material for weapons, verified either by closing facilities or opening the few remaining Russian plants to monitoring.

➤ Destroy all ballistic missiles that have been withdrawn from deployment,

except for a few that can be kept for space research and satellite launch. To make the missile ban stick, the two countries should agree to halt all production of long-range missiles.

STEP TWO: Shrink the arsenals of nuclear-weapon states to a bare minimum

In the second phase of our plan, the United States and Russia would cut their stockpiles to about 500 warheads, bringing them fairly close to parity with Britain, France, and China. Following this cut, these second-tier nuclear powers would join the United States and Russia in the process of irreversible disarmament. All five declared nuclear powers would lower their number of warheads to about 200—roughly the size of the smallest arsenal among them, that of Britain, and also about the size of the force that Israel is thought to be capable of assembling. As with the warheads withdrawn earlier, those removed from deployment would be dismantled and their fissile material (along with any other stocks of weapon-grade material) put under international monitoring.

All five weapons states would join other U.N. member states in a verifiable, universal treaty banning pro-

duction of fissile material for weapons. The "threshold" nuclear-weapons state—Israel, India, and Pakistan—would be expected to adhere, capping the potential size of their arsenals. China, Britain, and France would also destroy missiles that had been removed from deployment and end missile production, with limited exceptions for space launch. This action would launch negotiations on a worldwide ban on producing missiles with a range of more than 100 kilometers.

To prevent any use by the five powers of the remaining arsenals for surprise attack, warheads would be separated from land-based delivery systems (aircraft and missiles) and both would be stored on the territory of the owning country under multilateral monitoring. States could pull their nuclear warheads and delivery systems from monitored storage in the event of an acute national emergency or at the request of the U.N. Security Council, but the system would warn other nations if weapons were forcibly removed.

Because missile-equipped, nuclear-propelled submarines at sea cannot easily be placed under a regime that gives advance warning of possible weapon use, their number would have to be reduced drastically in the proposed five-power cuts. Each nuclear-weapon state could be allowed to keep only two, each armed with no more than three to four single-warhead nuclear missiles—too few for a crippling attack on others but enough to deter possible attack with unverified weapons.

STEP THREE: Stabilize a disarmed world

The last phase in the process of neutralizing nuclear weapons would entail developing global standards to minimize the risk that any nation will possess, use, or threaten to use such weapons.

In this phase, Israel, India, and Pakistan could relinquish their nuclear warheads and weapon materials altogether. Or they could place their materials in multilaterally monitored storage on their own territory, to be withdrawn only in conditions of national emergency. Countries that chose the latter option would become subject to stringent verification measures. Although they would have access to the material, they could not remove any of it from storage without warning international monitors.

As the number of nuclear weapons becomes very small and all but a few of the remaining warheads are separated from delivery vehicles, it will become all the more critical to make sure that no country retains secret stocks or has the capability to build them. Such an outlaw nation could gain an enormous strategic edge by threatening to use its weapons. Therefore, the five nuclear powers must, while committing themselves to no-first-use of nuclear weapons, also participate in an advance decision of the U.N. Security Council that the council will act immediately against any state or group initiating use of nuclear weapons or threatening to do so.

The International Atomic Energy Agency (IAEA) would have to be increased in size and power. It should have the capacity to conduct "anywhere, anytime" inspections, with untrammelled use of remote

sensors to monitor the air and water near a suspected facility. The now-voluntary activities of the London-based Nuclear Supplier Group, which exchanges information on transfers of nuclear components and sometimes blocks them, would become treaty-based obligations implemented by the IAEA.

The U.N. Security Council must act to ensure that all countries adhere to the practices that limit nuclear proliferation. The Security Council would formally decide to take joint action, including economic sanctions, against any state that declined to join the nuclear Non-Proliferation Treaty as well as the treaties ending nuclear testing and production of fissile material for weapons. Actions would also be taken against a country that refused to place its entire nuclear industry under IAEA controls. No state could be outside the non-proliferation regime.

To reduce the possibility that one of today's nuclear-weapon states might conceal or secretly produce some weapons, or that another country might covertly develop weapons, a limited capacity to retaliate against attack must be retained by the current nuclear-weapon states. These retaliatory weapons should be buried deeply underground in dispersed sites, guarded by ground-based antiaircraft and missile defenses. The six to eight submarine-based warheads that each nuclear weapon state could keep would also deter such preemptive attacks.

Finally, all nations would undertake to stop using plutonium as fuel for nuclear power reactors since the material can be used to make nuclear weapons. A country choosing to continue to rely on nuclear power would have to instead use low-enriched uranium, which is plentiful and which cannot be used to make a bomb without an extensive enrichment process.

After demonstrated success during the first three phases, the process of neutralizing nuclear weapons could be carried even further. A ban on missile-equipped submarines, for example, would make use of nuclear weapons on short notice almost impossible. Ultimately, all nuclear warheads and delivery vehicles might be dismantled, leaving only monitored stocks of fissile material.

During step two of a three-step process, all five declared nuclear powers would reduce their warheads to about 200—roughly the size of the smallest arsenal among them.



The steps outlined here would eliminate the risk of sudden, large-scale nuclear attack, drastically reduce the possibility that a nation would use nuclear weapons, and end threats of such use as an instrument of coercion. This plan would also make it extremely difficult for any country to secretly develop the ability to make a nuclear weapon. These weapons would thus cease to be a major factor in international politics.

Unfortunately, most of the world's political and military leaders cling to the belief that nuclear weapons play an important role in deterring not just nuclear war but also major conventional wars. Although there is no near-term prospect of a conventional world war involving any two or more of the great powers (the United States, Europe, Russia, China, and Japan), the official military doctrine of the nuclear-weapon countries still holds that nuclear weapons are a useful deterrent in case relations among these nations deteriorate. The link to conventional weapons is also strong because the developing countries with nuclear capabilities or nuclear ambitions—Israel, China, India, Iraq, Pakistan, and North Korea—are also among the most heavily armed Third World nations and the leading importers of armaments.

The process of neutralizing nuclear weapons must therefore include parallel efforts to reduce the risks of major conventional war. Systematic efforts to resolve major regional conflicts and to strengthen international mechanisms for "early warning," conflict resolution, and preventive peacekeeping must take high priority. At the same time, countries could reorient and restructure their conventional forces into more purely defensive postures.

While neutralization of nuclear weapons will be

difficult, the status quo is unacceptably risky. The most urgent nuclear danger comes from Russia's large numbers of weapons. Numerous incidents, fortunately still small in scale, illustrate the alarming possibility that warheads, fissile material, or nuclear components will "leak" from Russian government control through theft or illegal sale. Similar problems could arise in China, where nuclear testing continues, the armed forces are expanding, and a potentially destabilizing political transition will occur in the next few years. In the hands of more aggressive governments, the Russian and Chinese arsenals could endanger world peace. This grim possibility should give impetus to a movement to cut nuclear forces to a bare minimum and immobilize the remnant.

If steps to neutralize nuclear weapons are successfully maintained during a period in which nations also succeed in reducing their conventional weapons and in strengthening the U.N. as well as regional security organizations, the case for taking the final steps to abolish nuclear weapons will become irrefutable. ■

JONATHAN DEAN and RANDALL FORSBERG are coauthors, with William Driscoll and Gregory Webb, of *Nonproliferation Primer* (MIT Press, 1995). Dean, who advises the Union of Concerned Scientists on international security issues, was U.S. representative to the NATO-Warsaw Pact talks on force reduction held in Vienna in 1978-81. Forsberg founded and directs the Institute for Defense and Disarmament Studies in Cambridge, Mass. In the early 1980s, she authored the original proposal for a U.S.-Soviet freeze on the testing, production, and deployment of nuclear weapons.

MORE THAN
400 POWER PLANTS
OPERATING IN
30 COUNTRIES
AUTOMATICALLY
PRODUCE, AS PART
OF THE FISSION
PROCESS, SOME
70,000 KILOGRAMS
OF PLUTONIUM
EACH YEAR.

A Ban on Nuclear Technologies

Nuclear weapons and nuclear power are so strongly linked that both should be rapidly phased out.

THEODORE B. TAYLOR

FOR an instant after the Nagasaki bomb was detonated, an amount of energy equivalent to 20 million kilograms of dynamite resided in a sphere of plutonium no bigger than a baseball and weighing about 6 kilograms. Today, more than 400 nuclear power plants operating in 30 countries automatically produce, as part of the fission process, about 70,000 kilograms of plutonium annually. The world's inventory of plutonium produced in nuclear reactors now totals about 1 million kilograms, nearly five times the amount produced for the world's nuclear weapons. This so-called reactor-grade plutonium can be used for making a wide variety of nuclear weapons, as well as for making relatively crude, eas-



ily transportable nuclear explosives that could be used by terrorists.

To be used in nuclear weapons, the plutonium must first be chemically separated from the other materials in the spent reactor fuel, but the technology for doing this has been widely accessible for decades.

Although most nonmilitary plutonium is contained within stored spent uranium fuel awaiting decisions in some 30 countries about how to dispose of it, roughly 200,000 kilograms of plutonium has already been separated because some nations expect eventually to use it as a component of reactor fuel.

Most of the world's nuclear power plants require low-enrichment uranium—composed of only 3 or 4 percent of the isotope U-235, rather than the highly

enriched material used in weapons. But the enrichment plants that produce low-enrichment uranium can also be used to increase enrichment to nuclear-weapon grade. There are many different possible technical approaches to uranium enrichment and this technology is also proliferating rapidly.

Through their bomb programs, nuclear-weapon states have accumulated more than 1 million kilograms of highly enriched uranium (HEU). While this material has only rarely been used in nuclear power plants, large quantities have been diverted to R&D purposes. The world's inventory of nonmilitary HEU is now about 20,000 kilograms—enough for more than 2,000 nuclear warheads. Possession of bomb quantities of this material is by no means restricted to the announced nuclear-weapon states.

The time and resources needed to make the transition from latent to active production of nuclear weapons can be very small. Secret design and testing of non-nuclear components of nuclear warheads can allow a nation, or possibly a terrorist group, to build deliverable nuclear weapons in months, or even days, after acquiring a few kilograms or more of the key nuclear-weapon materials.

Combatants can also turn nuclear power facilities into nuclear weapons that release huge quantities of radioactive materials by bombing them or through sabotage. Bombing operating nuclear power plants or a facility for storing high-level radioactive waste from many reactors may represent the extreme upper limit of death and environmental chaos from violence initiated by small numbers of people.

I am convinced that the connection between nuclear weapons and nuclear power is so strong that all technologies for releasing energy from fission chain reactions should be rapidly phased out and then globally banned. I would also end further attempts to develop power plants based on nuclear fusion, since they could be used or modified to make neutrons very cheaply, which can then be used to produce cheap plutonium.

I do not propose to ban basic nuclear research or medical use of radioactive materials, provided such uses do not require materials that can sustain an explosive nuclear chain reaction. All radioisotopes that satisfy this condition could be provided by particle accelerators kept under close international scrutiny to ensure that they are not used to produce nuclear-weapon materials.

The major focus of global nuclear abolition, then, would be to ban any undisclosed possession or production of plutonium or enriched uranium. Stockpiles of these materials could be kept under international safeguards—awaiting final, irretrievable disposal—to prevent diversion, theft, sabotage, or accidents.

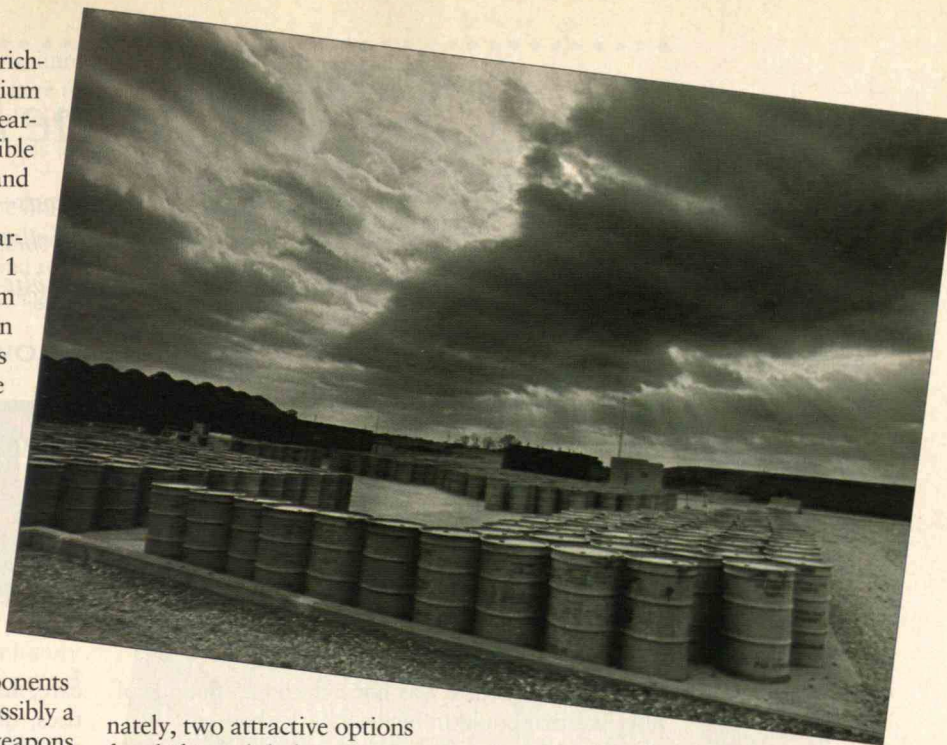
If nuclear power is phased out within a decade or two, how can the world make up for this loss of energy? The environmental consequences of continuing to rely on fossil fuels as the world's main source of commercial energy are unresolved, including continued controversy about climatic instabilities enhanced by large releases of carbon dioxide. Fortu-

nately, two attractive options for shifting global energy use away from fossil and nuclear fuels already exist: reducing demand by using energy much more efficiently, and shifting to locally appropriate, renewable forms of energy derived, directly or indirectly, from sunlight.

Efforts to conserve energy in buildings, industries, and transport vehicles are proving cost-effective even on relatively short time scales. Other technologies that show great promise in the near term, to name only a few, include wind power, algal ponds for converting sunlight to plant fuels, and pumped hydroelectric power to help meet energy demand at times of the day or year when levels of incident sunlight for solar electric cells are relatively low. Meanwhile, research is thriving on techniques for harnessing the sun to split water molecules to make hydrogen. The hydrogen can be used directly as a fuel or to increase production of other fuels such as methanol from biomass. Skeptics may ask whether communities can spare the space required to move to a solar-energy world. But at an overall average efficiency of 15 percent for converting incident solar radiation to some form of primary energy, less than 0.4 percent of the world's land area could supply present total energy demand.

The benefits of intensive, cooperative, worldwide action in response to these opportunities could be universal, huge, and prompt. Humankind now has the chance, perhaps for only a brief period, to reject the cosmic energy first released massively 50 years ago—energy that can much more easily be used to destroy than to build—and embrace the energy from our sun, which has, for a very long time, sustained all life on earth. ■

THEODORE B. TAYLOR, a physicist, worked for more than a decade on nuclear weapons and nuclear reactor design, first at Los Alamos National Laboratory and later in private industry. More recently he has devoted his efforts to fostering environmental protection, nuclear disarmament, and renewable energy sources.



Under a global nuclear ban, plutonium and enriched uranium could be kept under international control to prevent diversion, theft, sabotage, and accidents.

Clearing the Debris

Nuclear weapons have exacted heavy costs—economic, environmental, medical, political, and social—and these shadows will not recede without substantial public initiative.

BERNARD LOWN

THE scale of the devastation that took place at Hiroshima and Nagasaki 50 years ago was nothing new: the fire bombings of Dresden, Tokyo, and Hamburg had killed more people and induced equal havoc. The qualitative uniqueness of those atomic bombs was in the sheer concentration of their power. Instead of resulting from a 1,000-plane raid, the destruction was wrought by 25 pounds of uranium that could fit inside a basketball.

Yet compared with the power of today's weapons, the Hiroshima and Nagasaki blasts were mere puffs. A device like the Hiroshima bomb became the fission trigger for thermonuclear weapons—the match, so to speak, to light a fusion reaction that was 1,000 times more destructive.

The technological prowess of the atomic age gave rise to an unprecedented question: whether human beings, and indeed life on earth, had a future. The fact that either of the superpowers could destroy the other at will spread fear, suspicion, and distrust. Reason was suspended as the adversaries sought security in burgeoning arsenals of overkill.

The avowed rationale for possessing genocidal weapons was to deter their use. But if the intent had been deterrence, even a single bomb would have sufficed, since it could inflict unacceptable damage by destroying a metropolis like Moscow or Washington. Nuclear planners, like the sorcerer's apprentice, did not know how to stop, and eventually amassed 50,000 weapons. At the height of the Cold War, both superpowers had accumulated the equivalent of four tons of dynamite for every man, woman, and child inhabiting the earth. The race to Armageddon had no visible constraints, and it seemed inevitable that sooner or later we would get there.

Mercifully, the age of nuclear confrontation between the superpowers is over. Since the collapse of the Soviet Union, people have placed the nuclear threat on the back burner of their social concerns. But the Cold War and the nuclear arms race have left various kinds of debris that will not be cleared for many generations. From 1945 to 1992, U.S. military outlays amounted to \$11 trillion, half again as much as the present value of the entire American industrial plant and infrastructure. The resources expended on



the superpower confrontation could have solved all global health problems, with enough funds left to end world hunger, arrest population growth, and halt degradation of a fragile environment. Instead, after nearly five decades of fiscal neglect of the social sector, we must contend with decaying schools, potholed streets, deteriorating mass transit, inadequate health care, noncompetitive civilian manufacturing industries, dilapidated and inadequate housing, rotted urban centers, growing masses of homeless, and a pervasive drug culture. And it is perhaps no coincidence that both superpowers have experienced steep rises in violence and crime.

Another casualty is the standard of living, which for a majority of people in the two countries is declining and will continue to go down for the foreseeable future. In no small measure this stems from astronomical debt. For example, the U.S. government owes some \$4 trillion, incurred largely during the final decade of the Cold War. It is ironic that while the two superpowers have burdened generations of their children with debt, they invest only niggardly in their health and education.

Even though the United States suffers pain as a result of the Cold War, it has experienced a soft landing compared with Russia, where the consequences have been catastrophic in all sectors. Since 1992 the average life expectancy for Russian men has fallen from 62.1 to 58.9 years, 17 years less than in the United States. Infant mortality has risen from 18 per 1,000 to 19.9 per 1,000—more than twice our toll—just in the last year. Yet this year Russia has allocated less than 1 percent of its annual budget for health, about the magnitude of support encountered in sub-Saharan Africa. This egregious underfinancing occurs at a time when, as the Russian Health Ministry acknowledges, half the country's 21,000 hospitals do not have adequate plumbing, hot water, or modern means for sterilizing instruments. No wonder infection afflicts half of those undergoing surgery.

There is yet another awesome legacy of the Cold War. Both superpowers are facing mammoth technical challenges in dismantling their nuclear arsenals and coping with the growing garbage of the atomic age. Millions of pounds of highly radioactive reactor fuel are sitting in rusting storage vessels and are spreading radioactivity. Notwithstanding the \$3 billion the United States has spent in its search for a permanent waste repository, no solution is in sight for long-term

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disposal of plutonium and highly enriched uranium, and nuclear waste is accumulating with nowhere to go. There can be little satisfaction in knowing that the disposal problem in the former Soviet Union is an order of magnitude worse.

Yet I believe the most negative impact of the bomb is a cultural one. Science, once regarded as embodying the majesty of human achievement, is viewed with suspicion, disrespect, and even hostility. The image of the scientist conjures up Dr. Strangelove.

A Cloud over Science

From the eighteenth-century Enlightenment through the nineteenth century, a buoyant optimism reigned with regard to the human condition. Surely, it seemed, national and tribal passions would die out, and disease and poverty would be eliminated. This romantic positivism was propelled by the daily demonstration of the extraordinary potential of science and technology to enrich every facet of human life. Nothing in prior history had promised more abundance than the ever-upward advance of science, which affirmed life at its best.

The mushroom cloud, culminating two world wars in which the march of science and technology brought steadily worsening destructiveness, changed all that. Of course, it would be a vast oversimplification to blame all public disaffection with science on nuclearism, for a counterstrain of pessimism has always coexisted with popular faith in science. The attacks against Galileo started centuries ago and have never ceased. Frankenstein was dreamed up long before the atomic age. Nevertheless, it is safe to say that nuclear arms have contributed to a deepening public ambivalence. While craving the miracles wrought by modern medicine and eager to embrace technological conveniences, people have become suspicious of the scientific outlook in general. In a world perceived to be overrun with nuclear weapons and nuclear waste, carcinogenic agents of every description, ozone depletion, greenhouse warming, and reckless genetic engineering, science is no longer a moral beacon and a source of hope.

If there is one bright spot in the nuclear legacy, it is what the arms race has revealed about the human instinct for survival. Just as an organism develops antibodies to a threatening antigen, society appears to evolve immunologic mechanisms to cope with danger. The nuclear threat spurred millions of people to engage in social activism. A telling example was the burgeoning physicians' movement.

In a remarkably brief time, 200,000 health workers in nearly 80 countries responded to the call by the International Physicians for the Prevention of Nuclear War, and a novel brand of people's diplomacy sprang into being. Grassroots organizations such as this one spurred millions of people in both adversarial camps to penetrate the fog of denial and confront for the first time the unthinkable reality of nuclear war. It is no exaggeration to say that citizens' groups were instrumental in dismantling the Cold War.



Although the worst may now be behind us, experience has convinced many of us that the deadly nuclear shadow will not vanish without public education and involvement. Politicians do not respond to the beckoning of history. They rise to the challenge only when public opinion obstinately clamors for change. In this respect, citizen diplomacy is as essential now as it was at the height of the nuclear terror. The bestialities unleashed in Bosnia, Rwanda, and Chechnya provide evidence, if such be needed, that barbarism is just below the integument in all human societies, whatever their purported moral values or avowed religious persuasions. In the words of an Auschwitz survivor, the psychotherapist Victor Frankl: "Since Auschwitz we know what man is capable of. And since Hiroshima we know what is at stake." It would be no small contribution for generations yet unborn to declare genocidal weapons the exclusive property of the savage twentieth century. ■

BERNARD LOWN, a professor of cardiology emeritus at the Harvard School of Public Health and a senior physician at Brigham and Women's Hospital in Boston, was co-recipient with Eugene Chazov of the 1985 Nobel Peace Prize on behalf of the group they founded, International Physicians for the Prevention of Nuclear War.

Citizen
diplomacy
is as essential
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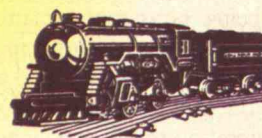
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The above programs are subject to change.

The Migration of Know-How

At a recent meeting in Tucson of the Engineering Deans' Council, Craig Barrett, the chief operating officer of Intel, made a startling statement. The quality of engineering services that the leading chipmaker obtains in other countries, Barrett informed the leaders of U.S. universities, is in many cases on a par with those offered in the United States.

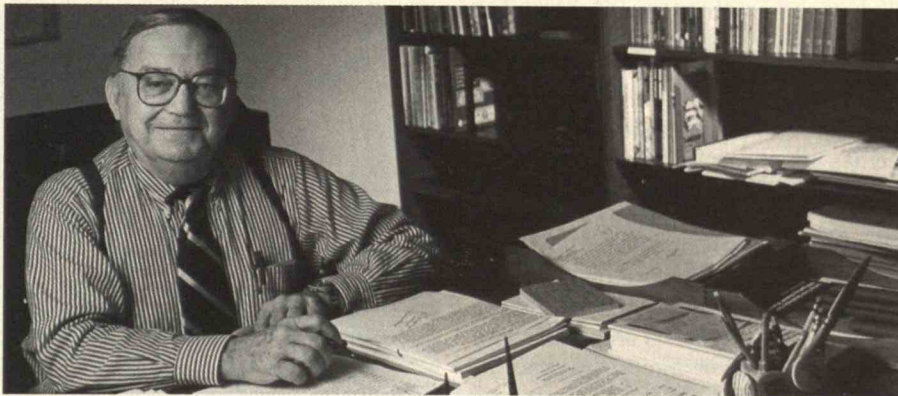
The once-preeminent U.S. engineering community is now facing tough competition in many industries. Automakers are doing more of their design and production work abroad, as are computer and semiconductor manufacturers. Aircraft manufacturers also rely more and more heavily on key components designed and engineered elsewhere. Construction companies operating abroad now depend on indigenous engineering services, or acquire them from third countries.

Technology has always moved from one country to another—from Europe to the United States during the 1800s, for example, and from the United States to Japan during this century. But the movement is accelerating, as corporations aggressively seek and employ top-quality and lowest-cost engineering services with diminishing regard for national boundaries. Advances in computing and telecommunications have made it more practical for companies to work interactively with engineers in remote locations. And engineering schools in the United States and other advanced industrial countries have become schoolhouses to the world. Foreign students received almost 55 percent of the engineering doctoral degrees awarded by U.S. universities in 1991, up from 40 percent in 1981. About half of them return to their home countries to strengthen their industrial and academic enterprises.

As the migration of know-how continues over the long run, other countries will strengthen their engineering-education institutions to make them more attractive to domestic and foreign students. China, India, South Korea, and Taiwan are together already producing almost as many engineers as the United States, Japan, and Germany combined.

In Eastern Europe and the states of the former Soviet Union, thousands of highly trained engineers released from military pursuits now search for useful civilian activities.

American engineers have to contend with the fact that they receive wages as high as 10 times those of engineers from developing countries. As other countries offer equivalent engineering quality, competing on wage rates is not a realistic option. Therefore, the U.S. engineering enterprise must find other ways to maintain overall comparative advantage. That means a focus on bringing products and processes to global markets faster than competitors. It also means continuing what U.S. industry does so well—designing and managing complex technological systems—without sacrificing leadership in key component technologies such as microchips, materials, and computer software.



When a company confronts international competition, it can take a number of actions to increase its chance of success: reallocate resources, strike deals, enter joint ventures, and produce new and better products to adjust to changing political and economic conditions. But a national engineering enterprise dispersed among thousands of individual organizations—companies, universities, and federal laboratories—cannot easily organize itself to do so. And nobody worries about the whole, even though the existence of a competitive U.S. engineering community directly affects the nation's economic and military security.

National policies necessary to main-

tain a world-class engineering establishment are thus essential. Among them must be a determination to advance the strength of the engineering-education system. As a practical matter this means that funding from federal, state, and private sectors must at least be maintained. Specifically, for example, the government should increase funding for grants awarded directly to engineering graduate students—a practice now common in biomedical research but not in engineering. Such grants, which give students considerable freedom in their choice of research focus, would encourage more U.S. undergraduates to pursue advanced engineering degrees.

Recent events in Washington are not encouraging. While the present congressional focus on support for basic science is to be applauded, the cuts in funding for engineering research are unsettling. The last Congress sliced \$200 million

from the Department of Defense's budget for academic engineering studies in such fields as computers and materials, and the present Congress is considering proposals to drastically shrink, or outright eliminate, the Department of Commerce's Advanced Technology Program.

The acceleration of technological migration is a wake-up call. Given the close link between technology and economic development, the country has a large stake in addressing this problem now. ■

ROBERT M. WHITE is president emeritus of the National Academy of Engineering and senior fellow at the University Corporation for Atmospheric Research in Washington, D.C.

The Age of Expendability

WHAT a comfortable world it was—peaceful, untroubled, and so predictable that a common worry was that people were becoming stale and conformist. Such was the vision of America in William H. Whyte's *The Organization Man*, a sociological classic of the 1950s that sketched the landscape inhabited by the nation's managers and technical professionals. Sheltered within the large, multi-unit business firm, "the organization man" applied his expertise to focused tasks required by stable, bureaucratic structures. Back at the suburban homestead, the housewife kept things neat and clean, cooking those special things her husband and children liked. Neighbors kept tabs on one another's acquisitions and lifestyles, making sure everybody "kept up with the Joneses."

How distant this bucolic picture now seems. Today's corporations, driven by the competitive pressures of the global economy, have slashed managerial and technical staffs by tens of thousands, throwing even the best and brightest into highly uncertain job markets. What once seemed like crucial layers of business hierarchy are obliterated as companies undergo mergers, restructuring and "re-engineering," often replacing the traditional core of loyal, long-term employees with temporary teams of consultants.

For today's engineers and managers, as for blue-collar workers, the expectation that one can build a stable career as an employee within a particular organization or industry is a fading dream. A more realistic strategy is to define oneself as a contractor—a person prepared to leap from job to job with a ballet dancer's verve. Personal and family relations must be modified as well; spouses and children must get used to rapid shifts in job hours and place of work.

While the 1950s organization men that Whyte described moved frequently too, these were mainly transfers within a company, or at least within an industry—and the changes usually brought an elevation in pay and professional status. American society at the time was predicated on upward mobility within stable

institutions; the country clearly hungered for tranquility and predictable advance.

But as "lean" corporations of the 1990s demand flexibility and rapid turnover, business gurus urge us to enjoy living on the edge of chaos, creatively confronting the challenge of each day's profit-making opportunities. Tom Peters, for example, in his recent book *The Pursuit of Wow*, advises people in the throes of career change to embrace "perpetual adolescence" because "we all need to be in the leaping business these days." No doubt some people flourish in this new rat race. But there are even larger numbers, I would bet, who are profoundly uncomfortable with the demands pressed upon them.

Among the hardest hit by the new conditions of corporate life are middle-aged technical professionals. Perhaps expecting to be rewarded for years of

reach their middle forties but decline thereafter as rounds of layoffs and job changes take their toll. Citing manpower studies by the Institute of Electrical and Electronics Engineers (IEEE) and the American Association of Engineering Societies, Trudy Bell, an editor at *IEEE Spectrum*, notes: "Not only are permanent jobs scarce, but many of the vacant ones pay 10 to 50 percent less than such positions paid only a few years ago and may also demand relocation." Thus, engineers may find themselves involved in a vagabond cycle of short-term jobs.

For a number of senior technical professionals I have known, economic stress is by no means the most troubling experience. Even more discouraging is the recognition that our society now assumes perpetual expendability. The quaint belief that an organization should offer its members steady, meaningful employment and a chance to make lasting con-



competent, faithful service, they often find themselves slated for elimination as their high salaries and benefits make them prime targets for corporate "savings." All too common are stories like that of Carll N. Pontius, Jr., a 1963 graduate of MIT who worked for decades in the aerospace industry in Los Angeles. Pontius was laid off in a wave of downsizing and now works as a ski patroller and emergency medical technician, and has just completed his training for a new career as a registered nurse.

The economic consequences of such career reversals are painfully obvious. Many engineers and managers nowadays see their incomes rise until they

tributions" to the common good has pretty much vanished. Instead people are judged by nearly minute-to-minute calculations of their value in the marketplace and sent packing if someone finds their productivity inadequate. Forgotten is the peculiar historical moment of four decades past when organization men—the true conservatives of their time—confidently sought corporate profits, self-esteem, stable families, and social harmony within the same working lives. ■

LANGDON WINNER is the author of *The Whale and the Reactor* and teaches science and technology studies at Rensselaer Polytechnic Institute. He can be reached at winner@rpi.edu.

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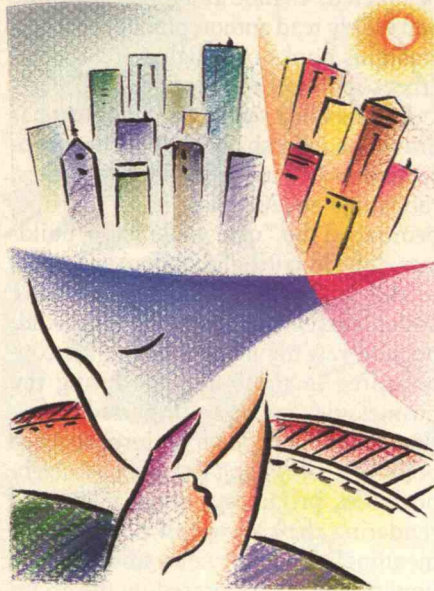
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BY THOMAS FRICK

THE concept of the sublime has a long and complex history. The Latin word *sublimis*, literally “up to the lintel,” connotes something exalted. The verb form, which has been employed in both chemical and alchemical contexts, refers to a process of purification. The Enlightenment philosopher Edmund Burke wrote that the sublime is invested with a salubrious terror that “turns the soul in upon itself.” And the nineteenth-century philosopher Immanuel Kant, borrowing from Burke, further categorized the sublime as either “mathematical”—a soul-stirring encounter with something of vast and humbling magnitude—or “dynamic”—referring to potentially devastating events such as floods or volcanic eruptions.

In *American Technological Sublime*, David E. Nye, professor of American studies at Odense University in Denmark and author of the award-winning *Electrifying America*, attempts yet another definition, one that focuses on the role the sublime has played in the development of the United States. It ends up being less a definition than a rubric for the often contradictory aspects of our nation’s burgeoning technological ambitions, but Nye’s work is valuable nonetheless, since his account of technological wonders and their rhetoric in the country’s imagination is consistently vivid and revealing.

The first wonder Nye studies, the completion of the Erie Canal, united “the militia, political leaders, merchants, mechanics, and the general public” in a self-con-



scious assertion of the value of their membership in a larger community, he writes. “A procession of canal boats wended its way from west to east, carrying a selection of products from the western states and territories that the canal would serve. The boats halted in every village of consequence for speeches, dinners, and fireworks.” Bands played; buildings and bridges were adorned with lights, flowers, and banners; flotillas, parades, banquets, and speeches abounded.

If the Erie Canal was the earliest celebration of our technological conquest, then the development of railroads was its apotheosis. So closely did the promotional impetus of the venture match the mood of the country that the Baltimore and Ohio Co., to inaugurate the first American railroad line, brought forward the last living signer of the Declaration of Independence, who uttered the less-than-immortal words, “I consider this among the most important acts of my life, second only to that of signing the Declaration . . . if, indeed, second to that.” And as with the completion of the Erie Canal, artisans and workers were integral to the pageantry. Nye points out that during the general celebration they “did not merely march; they also demonstrated their crafts as they moved

along the streets. The printers, aboard their car, printed an ode celebrating the day; the farmers threshed grain on one float and milked a cow on another; one of the painters completed a portrait.”

Deteriorating Relations

Change in the national mood was close at hand, however. One fascinating thread that runs through the industrialization charted in the early part of *American Technological Sublime* is the gradual exclusion of such members of the public from celebrations of technological feats. Labor-management relations were deteriorating; wage cuts during slack times and apathy toward worker safety were resulting in numerous, frequently violent, strikes. It also was becoming obvious that railroads did not unite the different regions of the country. In fact, they encouraged economic inequality and class conflict, by exploiting the products and labor of the South and West to advance the industrialization of the Northeast. The corporate structure of the railroads was modeled along military lines, so that local management of the work environment was ceded to centralized authorities.

In the 1869 “golden spike” ceremonies celebrating the meeting in Utah of railroad lines from east and west, a telegraph wire attached to the spike allowed crowds across the land to hear the hammer blows driving it into place. During the subsequent nationwide clamor, the note of American unity was sounded again and again. Yet Nye’s comment on the well-publicized photograph of the meeting of east- and west-bound locomotives is instructive: “Omitted from this image were the Chinese laborers who had chiseled and blasted a roadbed across the Sierras at wages of less than \$2 a day . . . The photograph also could not show that many of the workers had not been paid in weeks. A few days earlier, 300 men had blocked the line . . . to prevent the vice president of the Union Pacific from reaching the ceremony until they received back wages.”

The End of Sublimity

Nye goes on to recount similarly multifaceted stories about bridges, dams, skyscrapers, factories, and urban electricity networks. His chapter on skyscrapers is predictably one of the richest, for he is able to tap the wealth of commentary on these quintessential American icons. Here we find the novelist and dramatist Arnold Bennett commenting on the poetry of the Manhattan skyline: "some enchanted city of the next world rather than of this." And a strong mystical strain among architectural writers has attracted many of them to these heaven-storming structures. John Root, a Chicago architect who belonged to the mystical Swedenborgian sect, was one of the developers of the "floating raft" foundation, which allowed ever more massive structures to

be erected. Claude Bragdon, a prolific and widely read author, praised skyscrapers in his books on "higher space" and "theosophy and architecture."

But the other side of the argument has drawn its own share of illustrious proponents. The novelist Henry James, returning to America from Europe, bemoaned the "detestable" new buildings, "the horrific glazed perpendiculars of the future." Citizens' groups have added that skyscrapers are antisocial; because vast numbers of people are concentrated in the buildings during the business day and then dispersed to far-flung residences, such architecture has been seen as eroding the sense of neighborhood, promoting anonymity, and rendering the concept of public space meaningless. This view was perhaps unwittingly corroborated by the architecture critic Montgomery Schuyler, who remarked that "it is in the aggregation that the immense impressiveness lies."

Nye's colorful account of the technological projects of the late nineteenth and early twentieth century culminates in his chapter on the 1939 New York World's Fair. Unlike previous extravaganzas, this one permitted corporate exhibitors to dominate, both spatially and imaginatively. Nearly all major American companies enthusiastically participated despite another new development—the rents charged for exhibition space. Yet according to Nye, the advertising of products took second place to the advertising of the American technological future, in which "the long depression and the danger of war could be overcome." People were advised that utopia "was achievable by 1960."

Needless to say, no such future was in the cards. As the book moves further into the twentieth century, discussing the atomic bomb and Apollo XI, traditional definitions of the sublime that incorporate a strong element of fear become more apropos. After the first atomic test at Alamogordo on July 16, 1945, General Groves, the military officer in charge of the Manhattan Project, wrote of "a clarity and beauty that cannot be described," and, in the same paragraph, of the "awesome roar which warned of

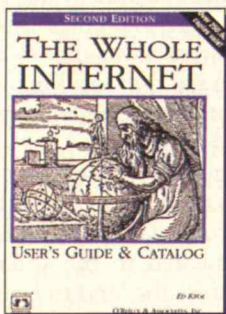
doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to The Almighty." Likewise, the literal and symbolic power of the Apollo and Saturn launches impressed early eyewitnesses in profound and complex ways. "The lift-off itself seemed to partake more of a miracle than a mechanical phenomenon," Norman Mailer reported. Even so, he compared the resultant noise to "the earsplitting bark of a thousand machine guns."

Interestingly, these heightened emotions give way to a kind of flatness. Nye's final chapter, "The Consumer Sublime," records what is, in a sense, the end of sublime experience—whatever its definition—through tourism, media overload, and a kind of "theme-parking" of real life: Nye notes that right outside the Grand Canyon National Park itself "525 people per hour can sit in an IMAX theater and watch *The Grand Canyon—The Hidden Secrets*, a 34-minute film shown on a 70-foot screen with six-track Dolby sound. As an additional attraction, the theater advertises 'Native Americans in traditional dress on the staff.' During the performance guests are encouraged to 'enjoy our fast food, popcorn, ice cream.'"

Unfortunately, however, Nye does not penetrate very far into the profundities of these developments, and at this point in the book, the need to go beyond historical anecdotes and interesting observations becomes pressing. For example, what exactly does it mean that media images are so much a part of our lives? If the sublime experience is dead, are we ourselves dead in some sense? What sense? And what might we do about it? Nye offers little help with such questions. We are left only with the vain hope that when the multitudes are happily strapped into their virtual-reality chairs, the world may open itself again to the experience of the truly sublime—the beautiful and terrifying, that which we do not control. ■

THOMAS FRICK is a critic and essayist whose work has appeared in *Art in America*, the *LA Times Book Review*, and the *Paris Review*.

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BOOKS

LIFE IN THE DIGITAL
BREAKDOWN LANE

Computer-Related Risks
by Peter G. Neumann
Addison-Wesley, \$24.75

BY SIMSON L. GARFINKEL

SEPTEMBER 17, 1991, was a nightmare for anybody traveling into or out of New York City. The city's long-distance telephone service stopped working for four hours, cutting communication between air traffic control centers. All three major airports were forced to halt operations, and 1,174 flights were delayed or canceled.

Officially, a power failure at a critical nexus of an AT&T network had shut down a switching system in lower Manhattan, but on a deeper level, the outage resulted from longstanding risks built into AT&T's lower Manhattan office. On that day in September, New York City's power company was short of electricity, so it declared a voluntary brown-out. Being a good corporate citizen, AT&T disconnected its switching system from the city's grid and turned on an emergency backup generator. Things started to go wrong immediately. The generator's hookup failed, leaving the system running on standby batteries. After six hours, the batteries went dead. They were equipped with alarms that should have warned of an impending power failure, but those alarms had been disconnected, since construction in the area had been setting them off. Even if the alarms had rung, it's doubtful that anyone would have heard them, however: the two people charged with handling emergencies were at a class on power-room alarms.

Stories like this are all too familiar to readers of the Internet Risks Forum (RISKS), the international online group moderated by computer scientist Peter G. Neumann. Contributors to RISKS have



written about everything from lost files to full-fledged disasters, and now, in *Computer-Related Risks*, Neumann presents the authoritative collection of those problems, along with his own reflections.

Such reflections are especially valuable given the richness of Neumann's historical perspective. The forum got its start back in 1985, when the Reagan administration was pushing ahead with its plans for a space-based Strategic Defense Initiative. The Association for Computing Machinery decided to take a stand against SDI on the grounds that the complex software needed to run the system would inevitably be riddled with faults, and it wanted to back that argument up with examples. Neumann established RISKS@CSL.SRI.COM to help gather them and stimulate discussion.

He got both, in spades: RISKS has become one of the most popular electronic magazines on the Internet. But even before he had assimilated and commented on all those computer horror stories, Neumann was eminently knowledgeable. A principal scientist at SRI International's Computer Science Laboratory, he had studied computer reliability and safety for more than two decades. He had also been among the

pioneers in computing, having worked on one of the earliest machines, the Mark I, at Harvard in the 1950s.

Judicious Mistrust

The book's first few chapters are a definitive catalog of computer-related woes. Neumann lists numerous failures in, for instance, computer networks, factory control systems, and space probes, and provides tables that attempt to characterize each accident, pinpointing the source of the failure.

What becomes clear is that many failures whose cause seems to lie in human error or mechanical breakdown actually stem from poor design and planning. For example, on June 27, 1991, telephone service in Washington, D.C., Los Angeles, and Pittsburgh was disrupted because a programmer had typed a "6" instead of a "D" on a line of code that had then gone into the telephone network's central computers without being tested. However, the real culprit was neither the typo nor the failure to test but the design of AT&T's software, which allowed a problem in one subsystem to disable the entire network.

Another telling case is that of the cement factory where a defective RAM chip shut down a conveyor belt, piling up the boulders used to make the cement and finally dropping them from 80 feet onto several cars in a parking lot. Neumann notes that the hardware or software could have incorporated error-correction codes or fail-safe checks to prevent such a mishap.

In addition to explaining the ways in which specific accidents could have been prevented, Neumann suggests how to keep the sheer numbers of accidents down, but this is where he will disappoint some readers. As he points out, formal analysis and provably correct computer programs aren't the answer, because the specifications on which they are based can be flawed. Extensive testing isn't the answer, because it is impossible to test for every situation that a computer program might encounter. Abandoning computers isn't the answer,

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either: many systems are too complicated to be run without them.

Neumann's lesson is that we should be careful about how much trust we place in computer systems. Just as safe drivers practice defensive driving, wise programmers will heed his advice to practice defensive programming, building systems with the assumption that parts will fail and programs will have bugs. They will design critical computer systems with many mutually reinforcing components. And there will always be some form of manual backup in place. The only difficulty is that so far, computer science really doesn't know how to build systems with such a limited potential for foul-ups: invariably, one component or program module is assumed to be bug-free, Neumann writes, and invariably, that is where the problem lies.

To minimize those assumptions and pave the way for a society where computers are used as intelligently as possible, he recommends that courses on risk analysis and the social consequences of technology become a formal part of every engineer's education. He has ideas about what the content of the courses should be as well. Indeed, he concludes every chapter with unsolved problems that could easily be adapted for classroom use. For instance, he invites the reader to consider the implications of automatic vehicle identification techniques that enable automated toll gates to charge a fee without requiring the driver to slow down, or that enable speeders to be ticketed automatically. Unfortunately, such systems have already been installed, usually without taking into account the fundamental risk they pose to privacy.

Given that our well-being, and sometimes our very lives, may depend on making serious attempts to weigh the costs of growing computerization and minimize the potential for harm, one can only hope that computer science departments around the world will start making *Computer-Related Risks* a mandatory part of their curricula. ■

SIMSON L. GARFINKEL is a freelance science writer whose most recent book is PGP: Pretty Good Privacy (O'Reilly & Associates, 1995).

SOMETHING TO CROW ABOUT

Editor Steven J. Marcus is right to crow about *Technology Review's* outstanding rankings in several categories of the "Opinion Leaders 1994" survey (*First Line*, TR April 1995).

Technology Review is the best, and has been for some time. Never mind the categories, such as "most enjoyable," where the magazine didn't place highly. I am delighted by objective news about science and technology, and I finish each issue of *Technology Review* with a distinct sense of enjoyment.

Regarding the "most current" category, I would like to note that your colleagues in the newspaper and television outlets are usually guilty of being too current. When something is happening in the world, it is not enough to simply describe it. The event needs to be placed within a context so that the reader can assess the degrees of change that today's event embodies. Many of the articles in *Technology Review* give one a perspective about what was true ten years ago and what is likely to be true ten years from now, along with today's developments. There is a spectrum that ranges from being overly concerned with the immediate to being overly concerned with the past, and the ideal of being current lies in the middle. On that basis, I rank *Technology Review* as number one in the "most current" category.

WAYNE T. WILNER
Mt. Lakes, N.J.

I caution *Technology Review* to resist the temptation to fiddle with the contents of future editions in order to rank higher in next year's survey. Part of the magazine's success comes from its ability to be both technical and readable, a formula that seems to have been developed internally rather than in response to a market niche. Change is inevitable, but it should be made from the gut and not in response to a so-called authoritative survey.

TED SHAB
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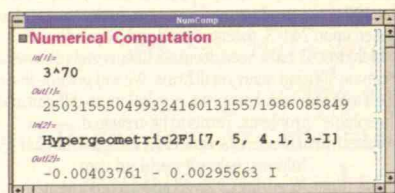
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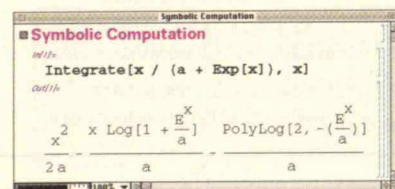
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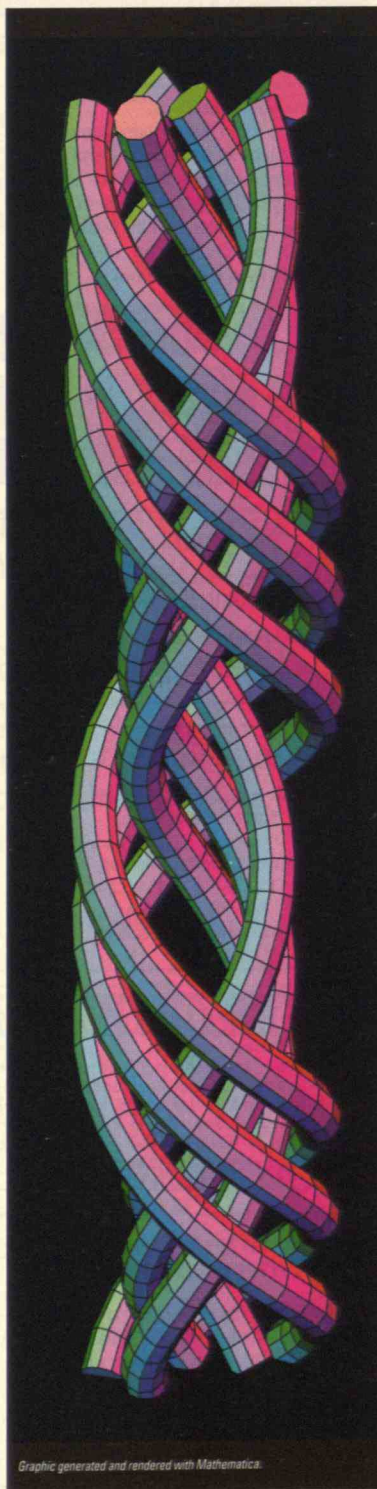


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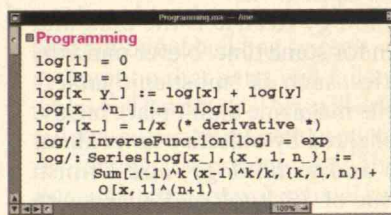
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